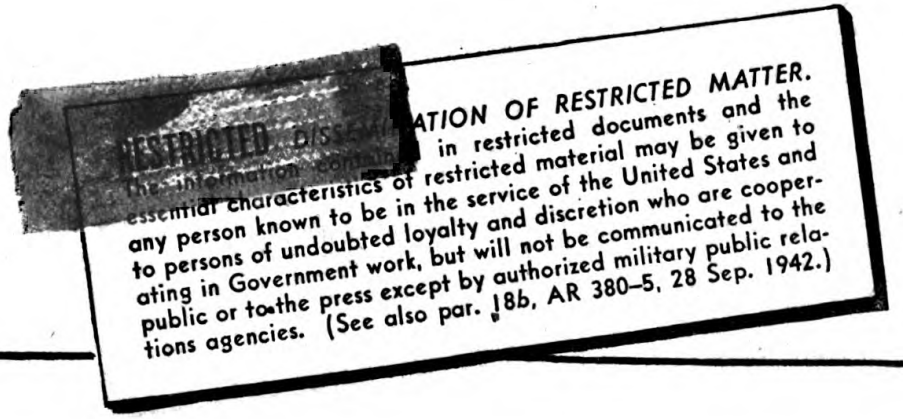
TM 3-290

WAR DEPARTMENT TECHNICAL MANUAL

U. S. Dept. of Army

MISCELLANEOUS GAS PROTECTIVE EQUIPMENT



WAR DEPARTMENT · 27 MARCH 1944

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WD CIR 373 1945

TECHNICAL MANUAL

MISCELLANEOUS GAS PROTECTIVE EQUIPMENT

UNIVERSITY of CALIFORNIA
APR 5 1948
DOCUMENTS DIVISION

CHANGES No. 2

WAR DEPARTMENT,
WASHINGTON 25, D. C., 7 September 1944.

TM 3-290, 27 March 1944, is changed as follows:

2.1 SECURITY MEASURES PERTINENT TO PROTECTIVE CLOTHING (Added). **a.** Impregnated clothing will be regarded as restricted matter in accordance with provisions of AR 380-5, and will not be released indiscriminately to civilians or civilian organizations for handling, processing, laundering, or salvaging. Release of impregnated clothing to civilians or civilian organizations in oversea theaters, and/or the continental United States for above-mentioned purposes will be made only upon approval of the commanding general or the commanding officer, with concurrence of the chemical officer and of the quartermaster of the theater or command concerned.

b. Issues of protective (impregnated) clothing in accordance with War Department policy to duly authorized civilians prior to embarkation overseas will continue to be made.

5. ISSUE. The Quartermaster Corps is the responsible agency for the issue of special clothing. Items of special clothing supplied by The Quartermaster General fall into two categories:

a. Items procured especially for subsequent impregnation and wear as protective clothing. These are:

Hoods, wool, od, special.
Gloves, cotton, special.
Drawers, cotton, special.
Undershirts, cotton, special.
Drawers, cotton, knit, short, special.
Drawers, cotton, women's special.
Undershirts, cotton, women's, special.
Gloves, cotton, women's, special.

*This change supersedes section II, War Department Circular No. 104, 1943.

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b. Items procured for general issue as part of individual clothing allowances. These include:

Suit, one-piece, HBT, special.
Jacket, HBT, special.
Trousers, HBT, special.
Shirt, cotton, khaki, special.
Shirt, flannel, coat style, od, special.
Trousers, cotton, khaki, special.
Trousers, wool, serge, od, special.
Shirt, HBT, women's, special
Trousers, HBT, women's, special.

c. Items normally issued to individuals and not modified in design to assist in gas protection, but which can be impregnated. These are:

Socks, wool, light, od.
Leggings, canvas, dismounted, od.
Leggings, canvas, od, women's.

10. FITTING. If permeable protective * * * permeable protective clothing. **All garments with the exception of leggings, hoods, and gloves are manufactured oversize to compensate for shrinkage. Leggings, hoods, and gloves are made in standard sizes only.** It is the duty * * * allow for shrinkage. Experience has shown that men are likely to require protective **socks** approximately one size larger than the unimpregnated **socks.** It is particularly * * * top button (fig. 12).

11. DONNING. In general, permeable protective clothing is put on in the order in which garments are listed in **the following subparagraphs:**

* * * * * * *

Figure 17. Binding of hood tucked around eyepiece.

Figure 18. Hood correctly buttoned (before adjustment).

12. UNDRESSING. Great care must be exercised in removing clothing which has been subjected to possible **liquid** contamination. In large fixed * * * existing tactical situation.

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13. PERSONNEL DECONTAMINATION STATION. a. Arrangement and procedure. Figure 20 shows * * * on the shoes. On entering the station, personnel remove rubber gloves (if worn), hoods, **leggings, shoes or boots, outer clothing, and gas masks in the order named,** depositing them in the appropriate bins. **If the contamination is very light such as that produced by exposures to blister gas vapor, it is not necessary to keep the gas mask on until all protective clothing except underwear, socks, and cotton gloves are removed.** After removing the * * * of collective protectors.

b. Handling contaminated garments and equipment. Personnel handling contaminated * * * handled with care. Laundered permeable protective clothing will be reimpregnated by a chemical processing company **if such reimpregnation is necessary as indicated by the kit for testing impregnite in clothing (ch. 4)** and returned to the Quartermaster Corps for reissue. Other contaminated items * * * decontamination station personnel.

* * * * * * *

14. LAUNDERING. Impregnated clothing should * * * temperature of 90° F. By the proper use of this formula, impregnated clothing may be laundered approximately **two to** four times before requiring reimpregnation, **the number of launderings depending upon the frequency and length of time of wear, length of time in storage prior to issue, and the gas concentrations to which the clothing has been exposed.** High water temperatures * * * of mild soap.

17. INSPECTION.

* * * * * * *

b. Issued clothing. (1) GENERAL. Officers in charge * * * must be reimpregnated. **In addition, dry-cleaning may result in damage to the cleaning plant by corrosion.** Garments that are * * * fits properly (par. 10).

* * * * * * *

47. PORTIONS TO BE TESTED (Superseded). **a. Stored impregnated clothing.** In baled storage, the portions of impregnated garments at the outside edge of the bales should be tested as such

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sections usually show the greatest deterioration. Garments in other types of storage should be tested at sections of double thickness of cloth, such as pockets, collar lapels, and cuffs of gloves. This eliminates the possibility of issuing garments which are not completely protective due to removal of protective agent for testing purposes.

b. Worn impregnated clothing. Sections of clothing subjected to friction, perspiration, and intense sunlight should be used as key points for testing, as the impregnite content deteriorates more rapidly in such parts. Examples of such sections are underarm, outside of sleeves, back of garment across shoulder blades, crotches, and upper front of trouser legs. Areas where double thickness of cloth are involved should not be used.

59. USE. One sack will hold two complete sets of clothing. When two complete outfits, **less shoes,** are deposited therein, the sack is sealed by folding over the top of the sack and tying the tapes tightly around the body of the sack. It is then * * * than 48 hours. **Shoes should be packed in separate sacks.)**

86. DESCRIPTION.

* * * * * * *

b. Components of the kit (fig. 66) are as follows:

1 kit carrier with carrying strap.
1 air-sampling pump, including flashlight.
36 mustard gas and nitrogen mustard gas detector tubes (blue **dot**).
20 nitrogen mustard gas detector tubes (red **dot**).
20 arsenical detector tubes (yellow **dot**).
20 phosgene detector tubes (green **dot**).
20 sampling tubes (**white dot**).
2 aluminum bottles of liquid reagent.

* * * * * * *

1 package of **waterproofed manila** envelopes with report cards (in rear pocket).
1 pencil (above rear pocket).

* * * * * * *

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88. PROCEDURE FOR MAKING TESTS.

* * * * * * *

b. Directions. (1) First test for mustard gas and nitrogen mustard gas by pulling off a blue **dot** tube from the clip.

(*a*) **Remove lead covering,** insert the end marked with a blue dot into the pump (fig. 69), and *slowly* take three pump strokes close to ground or suspected contaminated surface.

* * * * * * *

(2) To test for nitrogen mustard gases (only if a blue color appeared in the blue **dot** tube) pull off a red **dot** tube from the clip.

(*a*) **Remove lead covering** and insert the end marked with a red dot into the pump and *slowly* take three full pump strokes close to the ground or suspected contaminated surface. A pink color * * * nitrogen mustard gas.

(*b*) To confirm, remove * * * for 1 minute. A blue color in the blue **dot** tube and no orange-red color in the red **dot** tube indicate the presence of mustard gas.

(*c*) Proceed to step 3 (yellow **dot** tube) and test for arsenicals.

(3) To test for arsenicals, pull off a yellow **dot** tube from the clip.

(*a*) **Remove lead covering,** insert the end marked with a yellow dot into the pump, and *slowly* take three full pump strokes close to the ground or suspected contaminated surface. A blue color * * * ED or MD

(*b*) Now proceed to step 4 (green **dot** tube) and test for CG.

(4) To test for CG, pull off a green **dot** tube from the clip.

(*a*) **Remove lead covering,** insert the end marked with a green dot into the pump, and *slowly* take three full pump strokes close to the ground. A light green * * * presence of CG.

(*b*) Now proceed to step 5 (blue **dot** tube) and test for CC.

(5) To test for CC, pull off a blue **dot** tube from the clip. **Remove lead covering** and the aluminum foil heating pad. Insert the end * * * presence of CC.

(6) To sample a gas the identity of which is uncertain, for sending to a rear area laboratory, insert the end of a sample tube (**white dot**) into the pump and *slowly* take 30 full pump strokes in the area of highest concentration, such as indoors or just above a puddle of the suspected liquid.

* * * * * * *

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92. APPLICATION. The paint is applied by brush or spray to surfaces suitable for painting such as fences, lampposts, helmets, **leggings,** hoods or fenders of vehicles. It should constitute * * * sun while wet.

93. DURABILITY. The length of * * * or 3 weeks. **At least five successive layers of paint can be applied without excessive peeling.** Conditions of extreme * * * for camouflage purposes.

94. GENERAL. The *paper, liquid* * * * of blister gases. **Ordinary decontaminants such as those mentioned in paragraph 91 cause immediate color change similar to that produced by liquid blister gases, although bleach slurry has no immediate effect on the detector paper.** It consists of * * * cellophane cover (fig. 75).

95. APPLICATION AND USE.

* * * * * * *

c. The coated surface * * * liquid blister gas. **The color changes caused by mustard gas, lewisite, and the nitrogen mustard gases remain conspicuous for at least 48 hours. Paper which is applied to a surface lightly contaminated by blister gas shows color change after 10 seconds contact.**

96. SENSITIVITY. This paper has an outdoor sensitive life of **at least 2** months. Heat, steam, or oil act to decrease the sensitivity (par. 93). **Immersion in water, however, does not seriously affect the paper.**

97. DESCRIPTION. The *crayon, vesicant detector, M7,* is in the form of a bright pink crayon or chalk wrapped in waterproof paper (fig. 76). Contact with liquid mustard gas or its concentrated vapors, as well as with liquid lewisite and ethyldichlorarsine, methyldichlorarsine, and phenyldichlorarsine, and their concentrated vapors causes an immediate color change from pink to bright blue. It can be used to detect contamination under conditions in which the liquid blister gas detector paint would fail.

Section VI, Vesicant Detector Crayon M8, Chapter 6, is rescinded.

[A. G. 300.7 (2 Aug 44).]

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

As prescribed in par. 9a, FM 21–6; D (5); R (5); Bn (4); Bn 1 (6); C (5).

For explanation of symbols, see FM 21–6.

U. S. GOVERNMENT PRINTING OFFICE: 1944

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TECHNICAL MANUAL

MISCELLANEOUS GAS PROTECTIVE EQUIPMENT

CHANGES No. 3

WAR DEPARTMENT
Washington 25, D. C., 30 April 1945

TM 3-290, 27 March 1944, is changed as follows:

8. ISSUE AND USE (As changed by C 1) (Superseded). Permeable protective (impregnated) clothing will be issued to military personnel as required for use in theaters of operations as prescribed by War Department directives. Individuals in such areas require three classes of protection.

a. First-class protection. Provided, where gas attack is practicable, for individuals who will probably be in contact with enemy when gas warfare is initiated.

b. Second-class protection. Provided, where gas attack is practicable, for individuals who probably will not be in immediate contact with enemy when gas warfare is initiated, but who may be subject to attack by air other than long-range hit and run attacks.

c. Third-class protection. Provided, where gas attack is not considered practicable, for individuals who probably will not be in contact with enemy when gas warfare is initiated.

d. Precautions. Permeable protective clothing should not be worn in place of a raincoat for protection against rain or other wetting. The erosive action of water renders the clothing less protective. Decision as to whether troops are to wear permeable protective clothing rests with the theater commanders.

9. ITEMS (Superseded). A standard set of permeable protective (impregated) clothing for the various classes of protection consists of the following items:

a. First-class protection. Protective clothing as provided is of the two-layer type consisting of the following items:

* 1 pair *trousers, herringbone twill, protective*, and
1 *jacket, herringbone twill, protective*, or
1 *suit, one-piece, herringbone twill, protective.*

* Standard names by which equipment may be ordered appear in italics wherever they occur in the text.

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1 pair *drawers, cotton, protective.*
1 *undershirt, cotton, protective.*
1 pair *socks, wool, light, olive drab, protective,* or
1 pair *socks, wool, cushion sole, protective.*
1 pair *leggings, canvas, dismounted, olive-drab, protective* (except for individuals equipped with *boots, service, combat*).
1 *hood, wood, olive-drab, protective.*
1 pair *gloves, cotton, protective.*

b. Second-class protection. Protective clothing provided is of the 1½-layer type consisting of the following items:

1 *jacket, herringbone, twill, protective,* and
1 pair *trousers, herringbone twill, protective,* or
1 *suit, one-piece, herringbone twill, protective.*
1 pair *drawers, knitted, shorts, protective.*
1 pair *socks, wool, light, olive-drab, protective,* or
1 pair *socks, wool, cushion sole, protective.*
1 pair *leggings, canvas, dismounted, olive-drab, protective* (except for individuals equipped with *boots, service, combat*).
1 *hood, wool, olive-drab, protective.*
1 pair *gloves, cotton, protective.*

c. Third-class protection. No permeable protective clothing is provided with this class protection.

d. Accessories. Gas masks and shoes treated with shoe impregnite are necessary accessories to permeable protective clothing. Impermeable rubber gloves may be worn also, if issued.

e. Alternate items. In certain areas *shirt, flannel, coat style, olive-drab, protective* and *trousers, wool, service, olive drab, protective* may be issued in lieu of herringbone twill garments.

10. FITTING (As changed by C 2). If permeable protective * * * hood lining (fig. 11). **In issuing hoods to troops, due care must be exercised to see that the hood, which is issued in three sizes—small, medium, and large—is individually fitted to the wearer, taking into account both the type of gas mask worn and the wearer's head size. Reposition all three buttons on hood front closure, if this is necessary to insure a gastight seal at the junction of the hood face opening and the gas mask facepiece, and at the junction of the hood collar band and the collar of the jacket or suit.** Resetting the top * * * top button (fig. 12).

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11. DONNING (As changed by C 2). In general, permeable * * * the following subparagraphs. **Whenever possible, personnel should assist each other in donning protective clothing and, if necessary, in the application of protective ointment M5, to insure adequate protection. (Gas mask and shoes, treated with shoe impregnite, are essential accessories.)**

* * * * * * *

e. Gas mask (Superseded). In situations likely to require exposure to high concentrations of blister gas vapor for prolonged periods of time, use protective ointment M5 on neck and face to supplement protective properties of the hood. (See par. 69.1 *c.*) After using ointment, put on the gas mask.

* * * * * * *

13. PERSONNEL DECONTAMINATION STATION (As changed by C 2).

* * * * * * *

b. Handling contaminated garments and equipment. (1) Personnel handling contaminated * * * designated quartermaster laundry. **In order to avoid contamination, it is desirable that trucks be lined, particularly seats, with either heavy wrapping paper, salvage tarpaulins, roofing paper, torn gas-resistant sacks, or other similar articles, if available. Contaminated protective clothing deteriorates rapidly if kept even for as short a period as 1 day in closed containers such as gas-resistant sacks or tightly covered G. I. cans. For this reason such clothing should be removed from the gas-resistant sacks or other containers as soon as possible and decontaminated. If it is known that clothing cannot be decontaminated within 2 or 3 days, clothing should not be left in the containers longer than 12 hours but should be removed and aired in a shady, well-ventilated place.** Underwear removed in * * * decontamination station personnel.

(2) In decontamination work where chloride of lime is used, personnel wearing permeable protective clothing should be cautioned against letting chloride of lime slurry get on clothing as it has a powerful tenderizing effect on cotton garments and some effect on woolen garments. If slurry does get on clothing, it should be washed off immediately with water.

* * * * * * *

14. LAUNDERING (As changed by C 2) (Superseded). Permeable protective (impregnated) clothing should be laundered by the Quartermaster Corps standard washing formula "G." This formula re-

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quires a mild soap; the wash water is held at 90° F., and three washes of 5 minutes each are followed by three rinses of 3 minutes each in clear water. The Quartermaster Corps mobile laundry formula, using a synthetic detergent instead of soap, is also satisfactory if the temperature of the water is maintained at 90° F. No "sour" should be used in the last rinse as acid solutions attack the active protective agent. By the proper use of these formulas, permeable protective (impregnated) clothing may be laundered approximately one to three times before requiring reimpregnation, the number of launderings depending mainly upon frequency and length of time of wear, climatic conditions under which the clothing is worn, method of clothing impregnation, length of time in storage prior to issue, and gas concentrations to which the clothing has been exposed. Water of temperature of 90° F. and above and strong soaps and alkalies destroy the protective agent.

15. STORAGE. a. Conditions of storage.

* * * * * * *

(3) (Added.) Gasoline and other dry cleaning solvents remove the protective agent from permeable protective (impregnated) clothing. Personnel handling these solvents must be cautioned against spilling them on such clothing.

b. Deterioration in storage. Even under the * * * in temperate zones. Both stored clothing * * * the serviceable clothing.

c. Disposition of clothing which has lost its serviceable impregnite content (Added). It is necessary to report to Quartermaster for disposition of all garments which have lost their serviceable impregnite content.

d. Testing impregnite content (Added). In the event that Chemical Warfare Service personnel are not available, Quartermaster Corps personnel will determine chemical necessity for reimpregnation of protective clothing. Detailed directions for this test are found in chapter 4.

19. DISPOSITION OF GARMENTS.

* * * * * * *

d. Garments which are both physically defective and low in impregnite content will be repaired first **by Quartermaster Corps personnel, and then inspected by Chemical Warfare Service personnel to determine suitability of repaired clothing for reimpregnation. In the event that Chemical Warfare Service**

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personnel are not available, Quartermaster Corps personnel should inspect the repaired clothing to determine whether reimpregnation is practicable.

* * * * * * *

g. (added). Garments which are physically defective due to tenderizing effect of impregnite cannot be made serviceable by any means and will be destroyed.

30.1. DECONTAMINATION (Added). **a.** If impermeable protective clothing is heavily contaminated, it should be destroyed by burying or burning.

b. If it is necessary to decontaminate moderately contaminated impermeable protective clothing, decontamination can be accomplished by immersing clothing in boiling water until odor of blister gas has been removed. This treatment often results in some damage such as tears and holes which are readily visible. Such garments are salvaged.

c. If garments are lightly contaminated, aeration until all odor of blister gas has disappeared is sufficient.

* * * * * * *

46. PREPARING SOLUTIONS AND TESTING.

* * * * * * *

b. Test procedure. (1) Place one drop * * * to be tested. **Two drops of solvent are required to produce a satisfactory test of leggings.**

* * * * * * *

(3) (Superseded) After 10 seconds (not more than 15 seconds) blot the liquid from the cloth with a piece of test paper. The 10-second waiting period is very important and should be checked with a watch, if possible. Use a firm pressure while blotting, and make certain that the liquid on the cloth is taken up by the paper.

* * * * * * *

(6) Added) Instructions in TM 3–290 supersede instructions issued with kit.

58. DESCRIPTION (Superseded). The sack is constructed of four plies of reinforced kraft paper, each ply consisting of kraft paper laminated with asphalt cement. The sack is 56 inches long and 25 inches wide.

63. PACKING DATA (Superseded). Twelve empty sacks are packed in a waterproof, paper-lined, wooden box. Box is bound with metal strapping, weighs approximately 47 pounds, and has a displacement of approximately 1.86 cubic feet.

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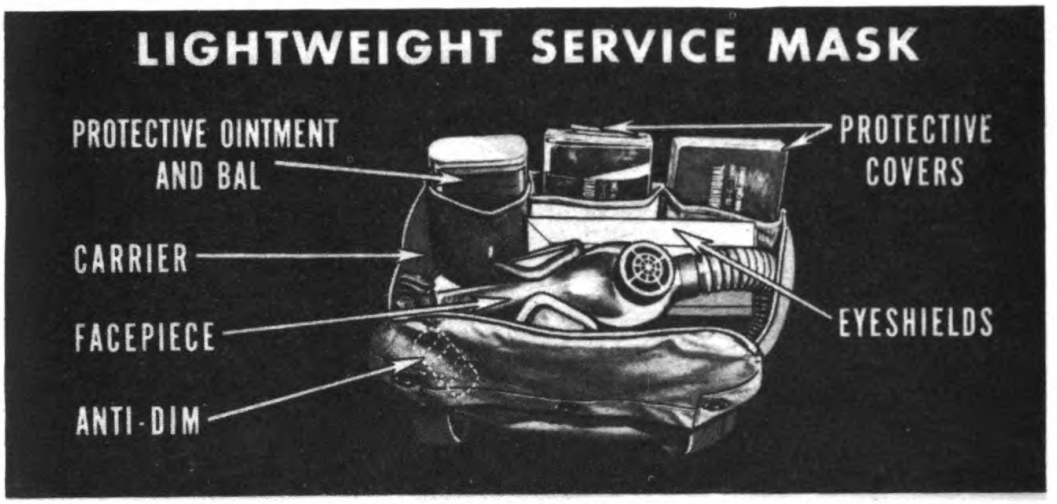

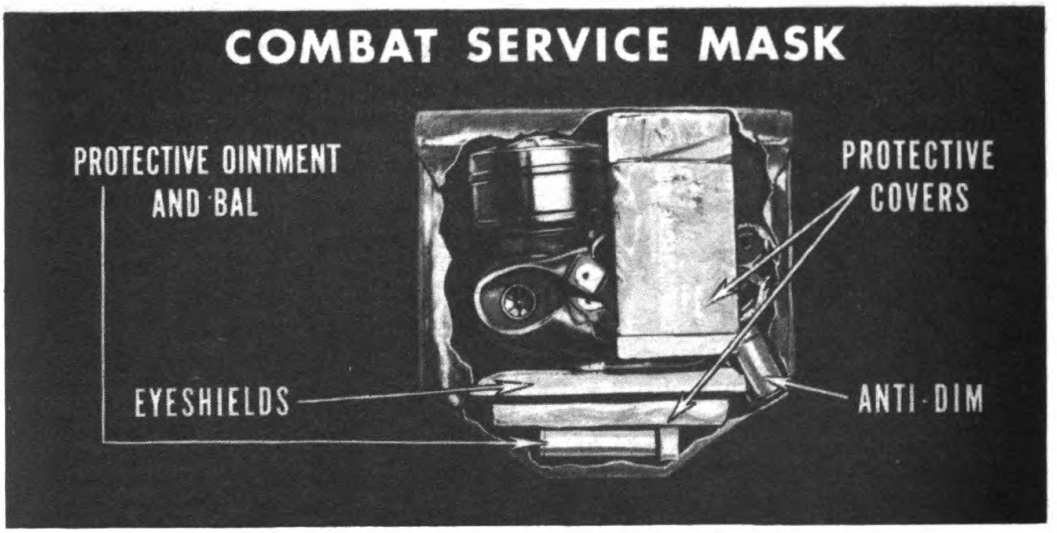

Figure 49. Carrying protective equipment.

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69.1. OINTMENT, PROTECTIVE, M5 (As added by C 1) (Superseded). **a. General.** M5 protective ointment is prepared for individual use to protect and decontaminate any area of the body, except the eyes, when exposed to blister gas.

b. Description. (1) *Interim pack.* Protective ointment M5 is issued in a pack containing four 18-gram collapsible tubes with break-off tips. Each tube is wrapped in absorbent cloth and rests in a papier-mâché liner within a can measuring 4¼ by 3⅜ by 1¼ inches. One tube of BAL eye ointment is fastened inside lid by means of waterproof adhesive tape. Top of can is sealed with waterproof tape. This pack is not waterproof. Directions are printed on can for use of both ointments.

(2) *Regular pack.* Can containing this package is waterproofed by a rubber seal and has metal clips which hold cap tightly in place.

c. Use. (1) *Protection against blister gas vapor.* Ointment, protective, M5 is used to protect unprotected parts of the body; as an adjunct both to Class I (two layers of protective clothing) and Class II protective clothing (one and one-half layer of protective clothing) when torn or improperly fitted; and to replace the protective hood and/or gloves in an emergency or when these items prevent effective operation. (See par. 8 for definitions of first- and second-class protection.) Wipe wet skin as dry as possible and then spread protective ointment in a smooth, even coating on all exposed skin. One tube is generally sufficient to cover the hands, neck, and that portion of the face not protected by the mask. Extend ointment on the face approximately 1 inch inside border of gas mask, avoiding the eyes. An overlap of at least 4 inches is desirable below collar line and above cuffs. When worn in atmosphere contaminated with blister gas vapors, reapply ointment at least every 3 hours. When worn in an emergency or in a special situation to replace the protective hood and/or gloves, it may be necessary to reapply the ointment hourly. The substitution of ointment for the protective hood and/or gloves necessitates the use of tie-cords or some other expedient to effect tight closures at the wrists and at the neck and, lacking a head covering, the application of ointment to the hair and scalp. The frequency of reapplication will be determined in all cases by local conditions such as weather, type of operation being performed, and concentration of the blister gas. An unbroken film of ointment must be maintained at all times to obtain complete protection. Wipe off excess ointment from the palms since this part of the hand is relatively insensitive to blister gas vapors. Ointment on palms can best be wiped on knees of

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trousers. Ointment in direct contact with the plastic lens in masks results in etching and fogging of the lens.

(2) *Decontamination of skin.* Protective ointment M5 protects against liquid blister gas for a short time. Decontaminate, as soon as possible, areas of skin contaminated with liquid blister gas, whether protected or unprotected by ointment. Blot free liquid blister gas from skin with absorbent cloth wrapping from one of the tubes of ointment or by using any absorbent material at hand. Apply ointment freely to area, remove excess, apply more ointment, and allow it to remain. If contamination with liquid blister gas is slight, no blotting is necessary; generous application of protective ointment M5 with thorough rubbing is sufficient.

(3) *Removal from skin.* After protective ointment M5 has been applied to the skin several times, it is somewhat difficult to remove. Dampening surface of skin with a small amount of any oily solvent such as gasoline, kerosene, mosquito repellent, or light oil softens ointment film and allows excess to be removed with gentle wiping. Soap and water remove the remainder.

72. ISSUE. Three grams of * * * break-off tip (fig. 59). **The ointment is issued as a component of the *kit, ointment, protective, M5* (par. 69.1).**

74. DIRECTIONS (Superseded). The impregnite is applied to all regular issue shoes. The amounts of impregnite must be worked into the shoes regardless of the time required. Absorption of the impregnite into shoes is facilitated by impregnation in a warm atmosphere. For shoes which have been treated, impregnation is required at weekly intervals as detailed in step 3 below. All shoes which have never been treated before are impregnated in the following steps. (The amounts of impregnite specified apply to 11-inch high *combat boots.* Amounts for use on other type footwear are in proportion to their heights.)

a. Steps. (1) On the first day brush mud, dirt, and grime from the shoes and remove lacings. Stir contents of can before using. Apply and keep an excess of impregnite on both the inside and outside of the shoes. Work as much impregnite as possible into the shoes by continually kneading and flexing the leather. Concentrate on the parts of the shoes where there are sewed seams and where there is only one thickness of leather. Allow shoes to aerate for at least 3 hours in a well-ventilated place. Repeat the above application and aeration and replace the lacings. Total impregnite required: 1½ cans.

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(2) On second day, wear shoes for at least 8 hours. Do not apply any impregnite.

(3) On third day apply impregnite to the outside of the shoes only, working the impregnite well into the leather. Wear for at least 8 hours. Total impregnite required: ½ to ¾ can.

(4) On fourth, fifth, sixth, and seventh days repeat step 3.

(5) Thereafter to maintain shoes in good protective condition, step 3 must be repeated once a week.

Note. In the event that less than 7 days are available for the treatment, the *daily schedule* in the above steps can be eliminated, and the treatment accomplished solely in regard to time required for application, aeration, and wear; and, in the event of an emergency, daub impregnite liberally on shoes and wear for immediate protection.

b. Cautions. (1) The impregnite for shoes is flammable.

(2) As the impregnite is poison, neither can nor content can be used for food purposes.

(3) The impregnite does not neutralize blister gas. It only prevents the liquid from penetrating the leather. Consequently, when shoes are contaminated with liquid blister gas, the liquid should be wiped off as soon as practicable. Handfuls of grass or leaves or any other material available can be used for this purpose. If possible contaminated shoes should be shuffled in a mixture of earth or sand and bleach.

76. PROCEDURE FOR USE OF KIT. a. Blister gases. (1) GENERAL. For relief of * * * area as required. **Use after reddening of the skin has appeared.**

* * * * * * *

85. GENERAL. The *kit*, *chemical* * * * reagents are added. The persistent gases detected are H (par 77b and c), the nitrogen mustard gases, L, ED, and MD. The nonpersistent gases detected are CG and CK.

86. DESCRIPTION. a. (Superseded.) The complete detector kit (figs. 64 and 65) consists of an olive-drab, cotton duck carrier, 8½ inches long, 5½ inches high, and approximately 3 inches wide; a carrier strap; and the contents listed in b below. The kit, with contents, weighs about 2½ pounds.

b. (As changed by C 2.) **Contents** of the kit (fig. 66) are as follows:

1 air-sampling pump, including flashlight.

* * * * * * *

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20 sampling tubes (white dot).
2 aluminum bottles for liquid reagent.
1 blue bottle for liquid reagent.
1 red bottle for liquid reagent.
1 aluminum vial of solid reagent (in pump handle).

* * * * * * *

1 pencil (above rear pocket).

c. (Superseded.) Air sampling pump is used to draw air samples through the detector tubes. Capacity of pump is approximately 90 milliliters of air per stroke. Head of pump piston contains a waterproof flashlight for use during night testing. When issued, the flashlight contains a dummy flashlight cell. Replace dummy flashlight cell with flashlight battery BA–42 (cell designation C). Flashlight is operated by pressing a push button, protected by a rubber diaphragm on side of head.

(1) Prior to use, check pump for effective suction in the following manner:

(*a*) Push in handle or piston as far as possible.

(*b*) Cover nozzle with finger and pull out on handle.

(*c*) After handle is held out in this manner for about 15 seconds, release it slowly so that it can be drawn into cylinder by vacuum maintained by holding finger over nozzle of pump.

(*d*) Handle of pump should return to within one-half of its closed position.

(2) If handle does not return to within one-half inch of its closed position, check the following:

(*a*) Leather cup on piston head of pump handle may become hard or distorted due to age, exposure, or storage at low temperatures. Repair by unscrewing cylinder cap, removing piston from pump cylinder, and flexing or adjusting cup with fingers.

(*b*) Nozzle of pump may become loose. Repair by tightening brass bushing which holds nozzle in pump.

(*c*) Pump may not function properly if dirt or other foreign matter is present inside pump cylinder. Wipe out dirt.

Figure 67. Air-sampling pump with flashlight.

(3) Flashlight assembly of pump is used without removing it from pump. If light fails, unscrew pump handle, remove from pump, and replace battery and bulb. Remove battery by pushing it out of its retainer, which permits access to bulb and spring. When replacing battery or bulb, place spring in pump head before bulb.

(4) Hollow pump handle contains three vials of solid reagents

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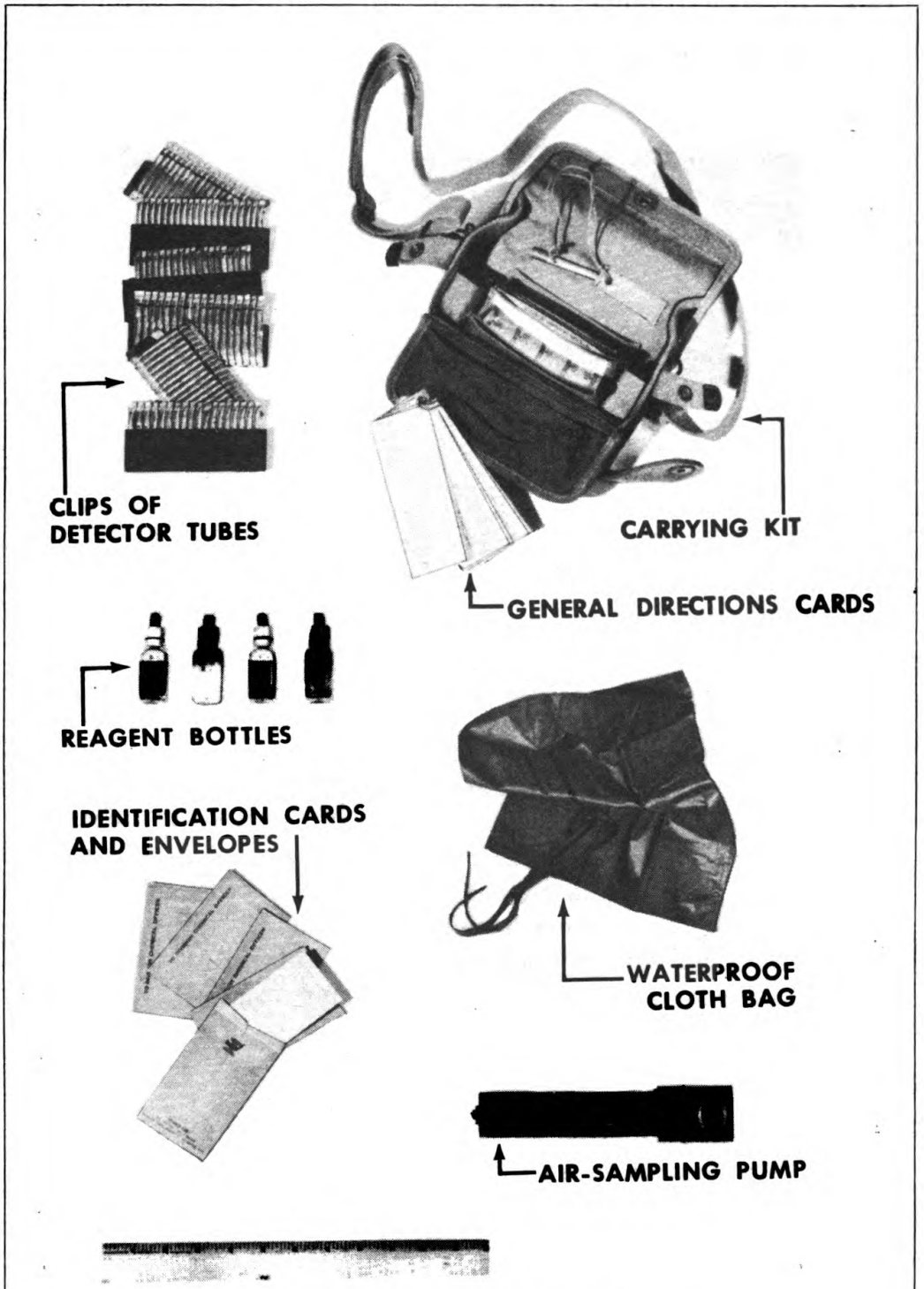

Figure 66. Detector kit M9.

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which are used as refills for the kit (fig. 68). For use of these reagents, see paragraph 88c (1).

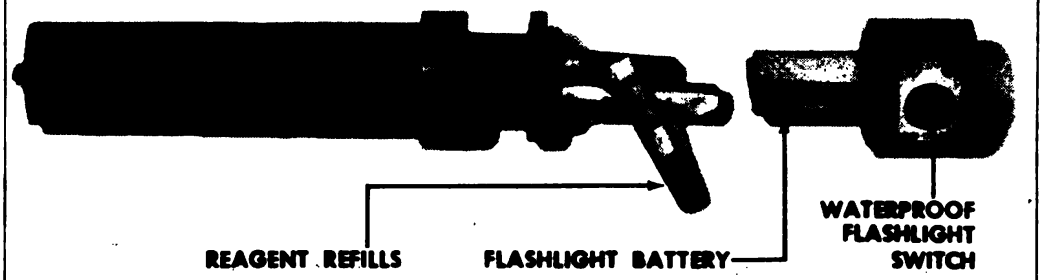

Figure 68.—Flashlight portion of pump removed to show battery and reagent refills.

87. PRINCIPLE OF OPERATION. a. (Superseded.) Principle on which this detector kit operates is as follows: air to be tested is drawn, by means of pump, through a tube containing a detector material which adsorbs gases. Each type of detector tube contains a different detector material which adsorbs and reacts to form a color with agent vapor to which it is sensitive. One type of tube, the mustard gas detector, requires treatment consisting of heating and using a developing solution to make color appear. The sensitivity of the arsenicals tube is increased if reagent from blue bottle is added to yellow dot (arsenicals) detector tube after contaminated air has been aspirated through tube (through the gel). Color appears in other tubes without treatment. Reagent solution in red bottle, if added to nitrogen mustard detector, provides a confirmatory test for nitrogen mustards. Intensity of color and length of colored ring produced in all tubes are roughly proportional to concentration of chemical warfare agent in the air.

* * * * * * *

88. PROCEDURE FOR MAKING TESTS.

* * * * * * *

b. Directions (As changed by C 2). (1) First test for * * * from the clip.

(*a*) Remove lead covering, **by pinching it against sharp edge of underlying glass tube and then spiralling off the cut lead covering.** Insert the end marked with a blue dot into the pump (fig. 69), and *slowly* take **five** pump strokes close to ground or suspected contaminated surface.

* * * * * * *

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(2) To test for * * * from the clip.

(*a*) Remove lead covering and insert the end marked with a red dot into the pump and *slowly* take **five** full pump strokes close to the ground or suspected contaminated surface. A pink color * * * nitrogen mustard gas.

* * * * * * *

(3) (Superseded.) To test for L, ED, or MD, pull off a yellow dot tube from clip.

(a) Tear off wrapper. Insert end marked with yellow dot into pump and *slowly* take five full pump strokes close to the ground or suspected contaminated surface. Add liquid from blue bottle to unmarked end of tube by means of dropper until grains are wetted. A blue color (see general directions cards, color chart, page 10) before addition of blue bottle liquid, or a light blue color after addition of liquid, indicates presence of L, ED, or MD.

(*b*) Now proceed to step 4 (green dot tube) and test for CG.

(4) To test for * * * from the clip.

(*a*) Remove lead covering, insert the end marked with a green dot into the pump, and *slowly* take **five** full pump strokes close to the ground. A light green * * * presence of CG.

(*b*) Now proceed to step 5 (blue dot tube) and test for **CK.**

(5) To test for **CK,** pull off a blue dot tube from the clip. Remove lead covering and the aluminum foil heating pad. Insert the end marked with a blue dot into the pump and *slowly* take **five** full pump strokes close to the ground. A yellow color indicates the presence of **CK.**

* * * * * * *

c. Miscellaneous information on procedure. (1) (Superseded.) Prepare reagent solutions by removing blue, red, and aluminum vials from lead containers of this set and emptying contents of each vial into correspondingly colored bottle from kit. Add clear, unchlorinated water (preferably distilled water, not salt water) to bottles until each bottle is one-fourth full. Shake well. Add more water until bottles are full; shake thoroughly. Return bottles to kit. Keep paper collars in place until kit is used in field, then discard collars.

* * * * * * *

89. USE. a. Detection of dangerous concentrations of war gases. (1) (Superseded.) In interpreting results obtained by means of these detectors as described by general directions cards (pp. 11 to 14), it must always be remembered that air over a contaminated area does not contain uniform amounts of war gas since concentration is largely influenced by temperature, wind, and distance from contaminated

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surfaces. Samples should be taken at several points in area and at several heights from ground.

(2) The detector tubes are sufficiently sensitive that five full strokes of the pump will detect a concentration of the gas far below the concentration necessary to cause casualties in 50 percent of unprotected troops. (See chart below.)

* * * * * * *

90. LIMITATIONS (Superseded). Limitations to use of detector tubes in M9 kit are indicated below:

a. In addition to H and HN, the blue dot tubes show a color change with certain of the tear gases such as CN, CK, if present in sufficient amount, shows up, but as it is a direct test, does not require development.

b. Red dot tubes and red bottle reagent exhibit color changes similar to those produced by HN when tubes are exposed to products of decomposition of organic substances such as manure. HN, therefore should be judged to be present only when a positive result is obtained with blue dot tubes, red dot tubes, and red bottle reagent.

c. Yellow dot tubes are sensitive only to arsenicals, such as ED, MD, or PD. Tubes also detect L provided test is developed by addition of liquid reagent from blue bottle. Observations of color changes in these tubes are best made about 30 seconds after exposure, since this time lag permits test colors to deepen.

d. Green dot tube is sensitive to DP as well as to CG. Green color produced by either of these agents is subject to fading, and it is desirable that observations be made immediately after exposure of tubes.

91. GENERAL. **a.** The paint, liquid * * * wherever they strike. Ordinary decontaminants such * * * as blister gases.

b. The paint is * * * and 32 ounces. (Fig. 73 shows the 32-ounce can.)

92. APPLICATION. (As changed by C 2.) The paint is applied by brush or spray to surfaces suitable for painting such as fences, lamp-posts, helmets, hoods, or fenders of vehicles. It should constitute * * * fenders of vehicles. Although the paint * * * sun while wet.

Figure 74, Detector paint used as camouflage paint on helmet, page 80, is rescinded.

99. USE.

* * * * * * *

b. Differentiation. Rescinded.

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105. DESCRIPTION. The M1 alarm consists of three main components (fig. 77): shoulder **strap,** gong, and striker.

a. The shoulder **strap is** made of olive drab, cotton webbing and **is** adjustable.

* * * * * * *

c. The striker consists * * * approximately 5 pounds. **When alarm is not in use, wooden handle of striker is inserted into one side of U-shaped gong and held in place by a cotter pin. Since moisture expands wooden handle of striker to the point where it cannot easily be withdrawn from gong, using organizations should eliminate this trouble by removing wooden shoulder just below steel striker head with a rasp, knife, or lathe, if available. Entire handle should then be sandpapered smooth and shellacked. If handle is so tightly wedged into gong that it cannot be removed without damaging striker, striker handle, or gong, store alarm in a hot, dry room until it dries sufficiently to remove handle easily; then proceed as above. In summer, alarm may be left in sun until dry.**

106. ASSEMBLY AND USE. **a.** To assemble and * * * not in use. Next, hold the shoulder **strap** and striker as shown in figure 78 and strike the interior sides of the U-shaped gong. It is not * * * other convenient place.

* * * * * * *

[AG 300.7 (27 Mar 45)]

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J. A. ULIO
Major General
The Adjutant General

G. C. MARSHALL
Chief of Staff

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WAR DEPARTMENT TECHNICAL MANUAL

TM 3-290

This manual supersedes section IV, Training Circular No. 90, War Department, 1942; Training Circulars Nos. 11, 63 and 127, War Department, 1943.

MISCELLANEOUS GAS PROTECTIVE EQUIPMENT

WAR DEPARTMENT • *27 MARCH 1944*

RESTRICTED. *DISSEMINATION OF RESTRICTED MATTER.* The information contained in restricted documents and the essential characteristics of restricted material may be given to any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies. (See also par. 18*b*, AR 380-5, 28 Sep 1942.)

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WAR DEPARTMENT,
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TM 3-290, Miscellaneous Gas Protective Equipment, is published for the information and guidance of all concerned.

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Figure 1. Impermeable type protective clothing (adjusted) (for men).

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This manual supersedes section IV, Training Circular No. 90, War Department, 1942; Training Circulars Nos. 11, 63, and 127, War Department, 1943.

CHAPTER 1

GENERAL

1. PURPOSE AND SCOPE. a. Purpose. The purpose of this manual is to supplement FM 21–40 so far as it concerns certain protective equipment and supplies for use in chemical warfare.

b. Scope. The text is limited to the description, use, maintenance, and destruction of miscellaneous gas protective equipment *not* included in TM 3–205, 3–220, 3–221, 3–222, 3–230, and 3–350.

2. DESTRUCTION OF MISCELLANEOUS GAS PROTECTIVE EQUIPMENT. a. General. When circumstances force the abandonment of chemical warfare materiel in the field, it is destroyed or otherwise rendered useless to the enemy.

b. Procedures. (1) EQUIPMENT. (*a*) Protective clothing of all types, protective covers, and gas-resistant sacks are effectively destroyed by burning. Stack the equipment in piles, making each pile as large as it is compatible with safety, and leaving boxed equipment in containers. Arrange each pile to provide ample draft, saturate with oil or gasoline, and ignite. Personnel will keep upwind of the fire.

(*b*) In the cases of the H vapor detector kit M4, the kit for testing impregnite in clothing M1, the chemical agent detector kit M9, and the field impregnating set M1, break containers with an ax or sledge and spill contents.

(2) SUPPLIES. (*a*) Liquid vesicant detector paper, vesicant detector crayon, shoe impregnite, protective ointment, and eye ointment are burned. They are stacked in the manner prescribed in (1)(*a*) above, saturated with oil or gasoline, and ignited.

(*b*) Containers filled with liquid vesicant detector paint are broken open with an ax or sledge and their contents spilled.

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CHAPTER 2

PROTECTIVE CLOTHING

SECTION I
SPECIAL CLOTHING

3. GENERAL. a. Special clothing is defined as *unimpregnated* articles of wear so modified in design as to assist in gas protection. Upon impregnation it becomes permeable protective clothing.

b. Special clothing gives slightly more protection against blister gases (vesicants) than regular issue clothing since it is designed to prevent free access of these vapors to the body. Its main value lies in the modifications of design. *After special clothing is impregnated,* it gives far better protection against blister gas than does ordinary issue clothing which has been impregnated.

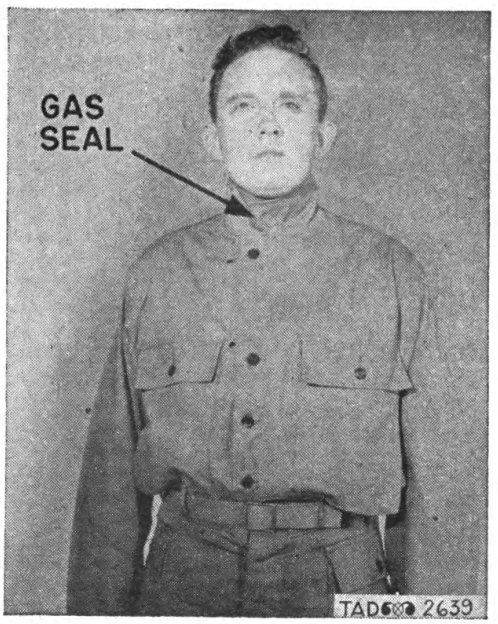

Figure 2. Collar adjustment

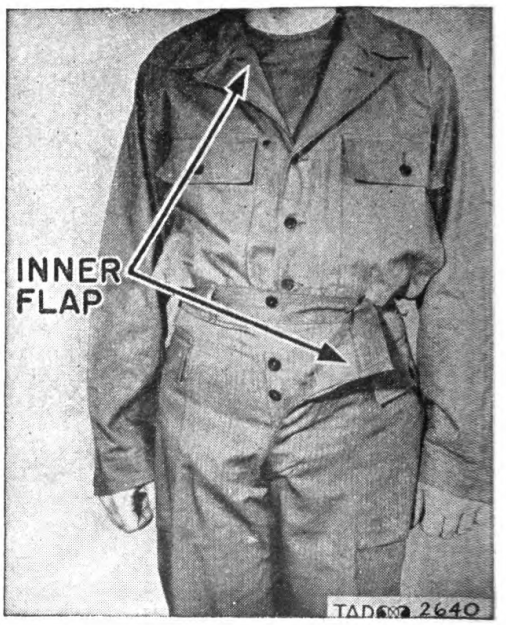

Figure 3. Protective design features of jackets and trousers (for men)

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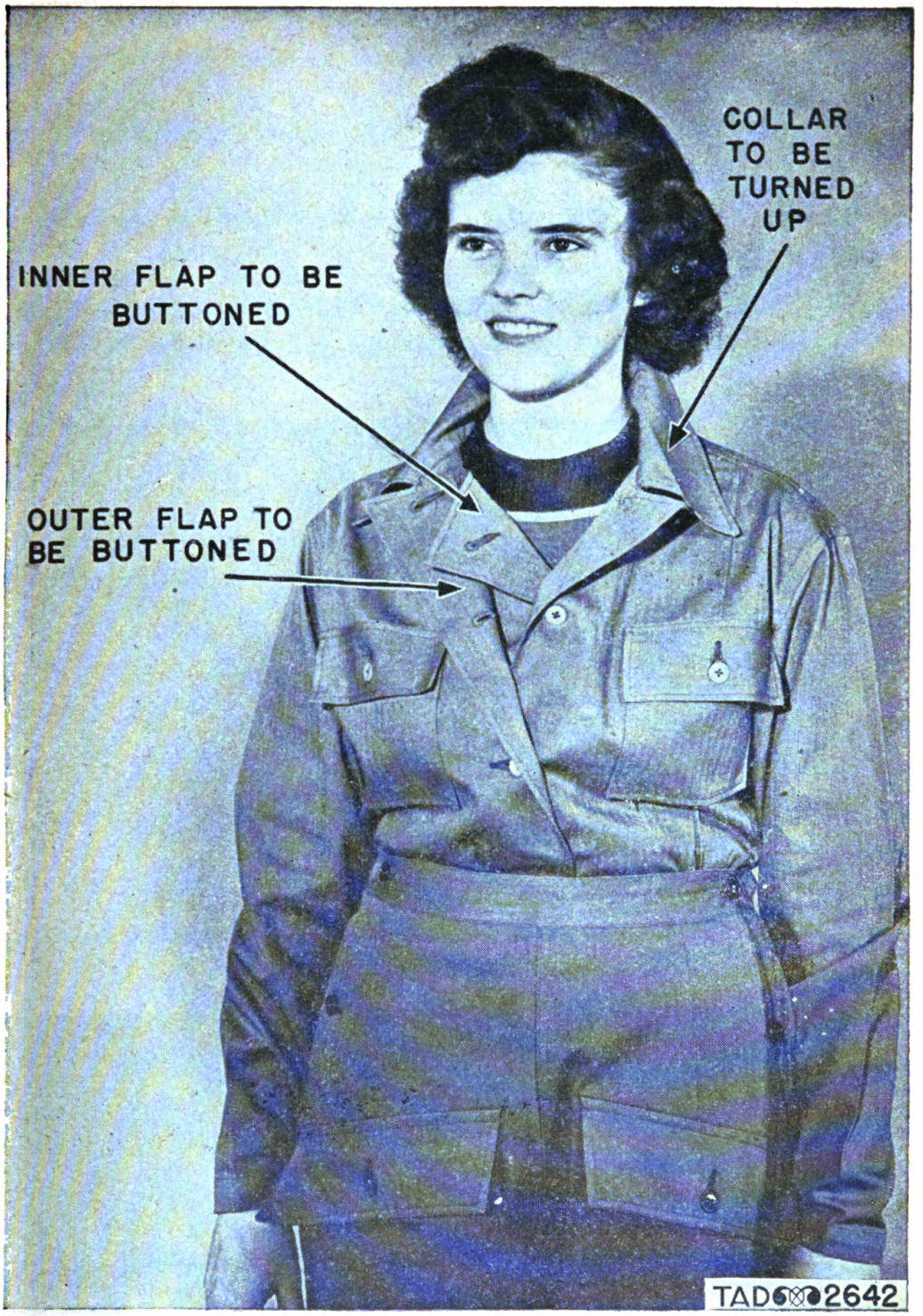

Figure 4. Protective design features of shirts (for women)

4. DESCRIPTION. Special clothing, in contrast to regular clothing, is characterized by the following definite features:

a. Collars on shirts, coveralls, and jackets are wider than on regular issue garments. When the collar is turned up and the tabs folded over, a satisfactory gas seal is formed (fig. 2).

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b. Inner flaps have been introduced into shirts, jackets, and trousers. They button on the inside and opposite to the usual exterior buttons to assure a gas seal (figs. 3, 4, and 5).

c. Full sleeves which permit folding, with tightly buttoned wrist bands, provide good sleeve closures (fig. 6).

5. ISSUE. The Quartermaster Corps is the responsible agency for the issue of special clothing.

6. STORAGE, SHIPMENT, AND MAINTENANCE. Storage, shipment, and maintenance of special clothing are the same as for ordinary issue clothing (AR 615–40).

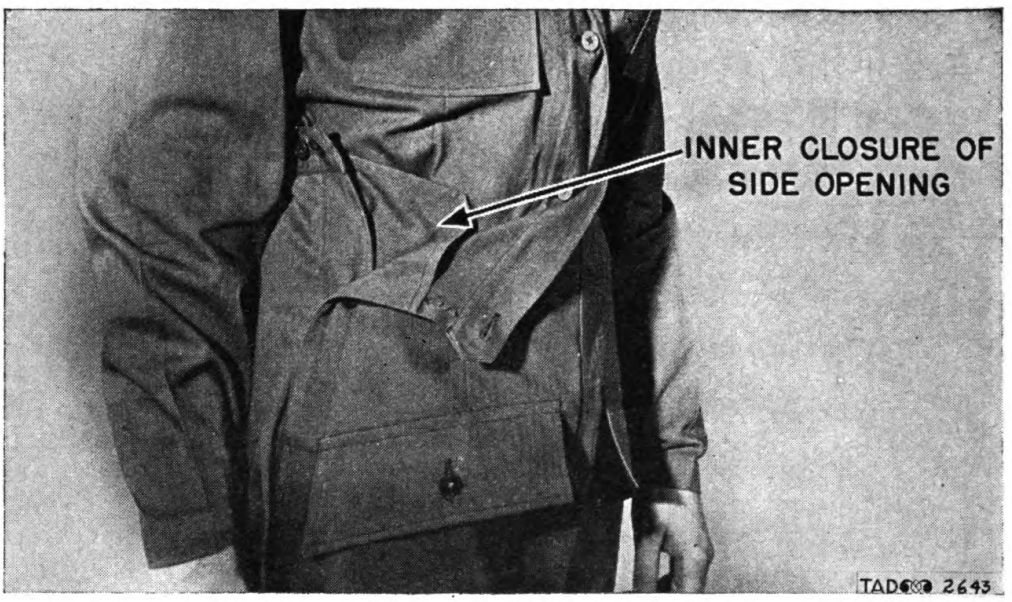

Figure 5. Side opening inner closure on trousers (for women)

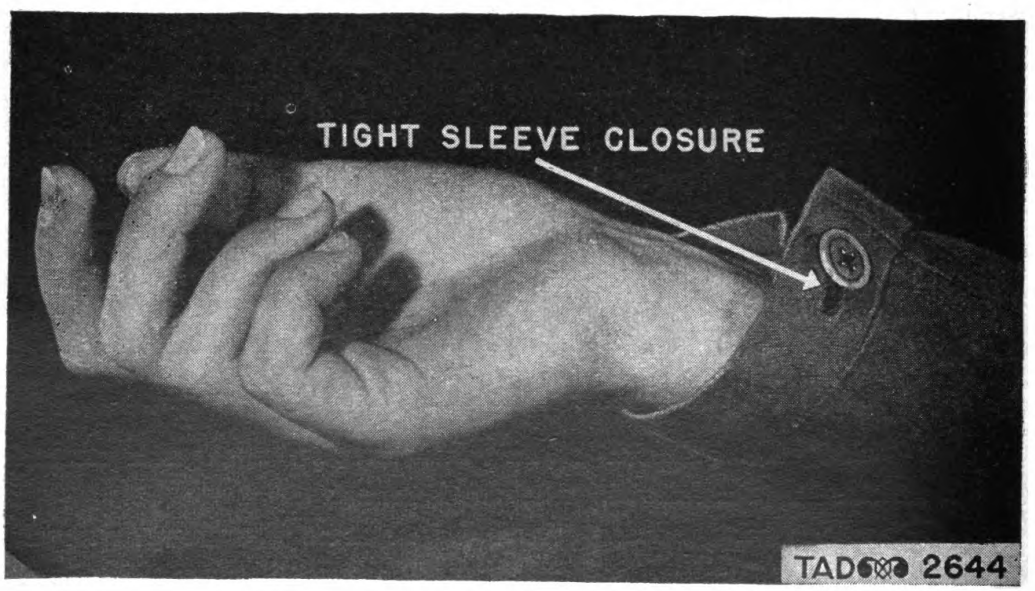

Figure 6. Sleeve closure (for women)

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SECTION II
PERMEABLE PROTECTIVE CLOTHING FOR MEN

7. GENERAL. Permeable protective clothing is special clothing (sec. I) which has been made protective against blister gases by impregnation (figs. 7, 8, and 9). (In case of necessity ordinary issue clothing may be impregnated.)

8. ISSUE AND USE. Permeable protective clothing will be issued to all military personnel for use in theaters of operation. It should not be worn in place of a raincoat for protection against rain or other wetting. The erosive action of water renders the clothing less protective. Decision whether troops are to wear permeable protective clothing rests with theater commanders.

9. ITEMS. A standard set of permeable protective clothing consists of the following items:

*1 *undershirt, cotton, protective.*
1 pair *drawers, cotton, protective.*
1 pair *socks, wool, light, protective.*
1 *jacket, herringbone twill, protective* and *trousers, herringbone twill, protective* or
1 *suit, one-piece, herringbone twill, protective* (coverall).
1 pair *leggings, dismounted, canvas, protective.*
1 *hood, wool, protective.*
1 pair *gloves, cotton, protective.*

10. FITTING. If permeable protective clothing is to be effective, it must fit comfortably and cover the person completely when the occasion calls for protection. In order to insure complete coverage, the protective features of the garments must be correctly adjusted, buttons must be in place, and fit of the garments must be such that openings can be closed effectively. It should be remembered that impregnation and laundering cause some shrinkage of permeable protective clothing. The one-piece permeable protective suit (coverall) is manufactured oversize to compensate for shrinkage. Other garments, however, are made in standard sizes only. It is the duty of officers issuing such clothing to see that garments are sufficiently large to allow for shrinkage. Experience has shown that men are likely to require permeable protective clothing approximately one size

* The standard names by which equipment may be ordered appear in italics wherever they occur in the text.

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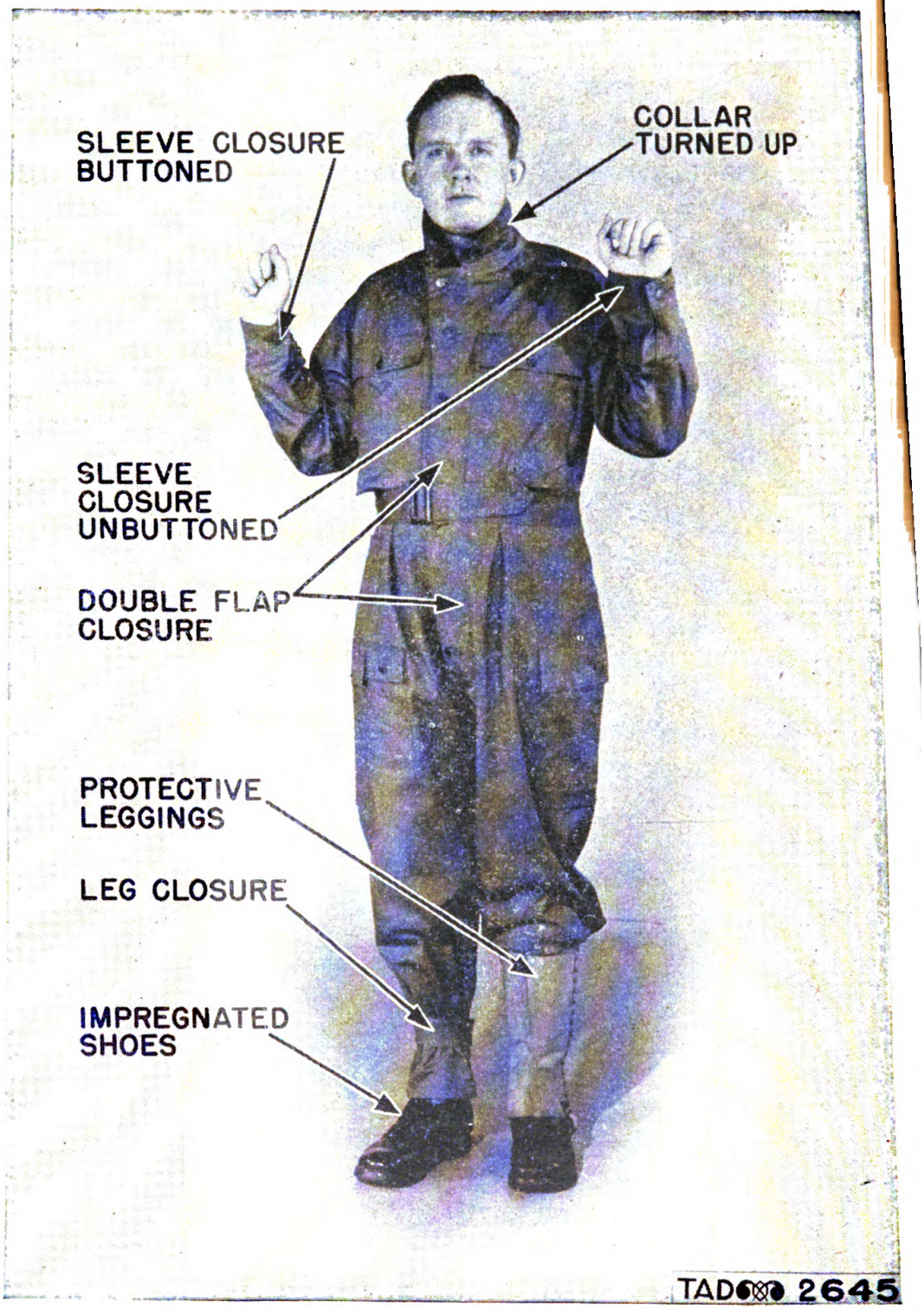

Figure 7. Suit, one-piece, herringbone twill, protective

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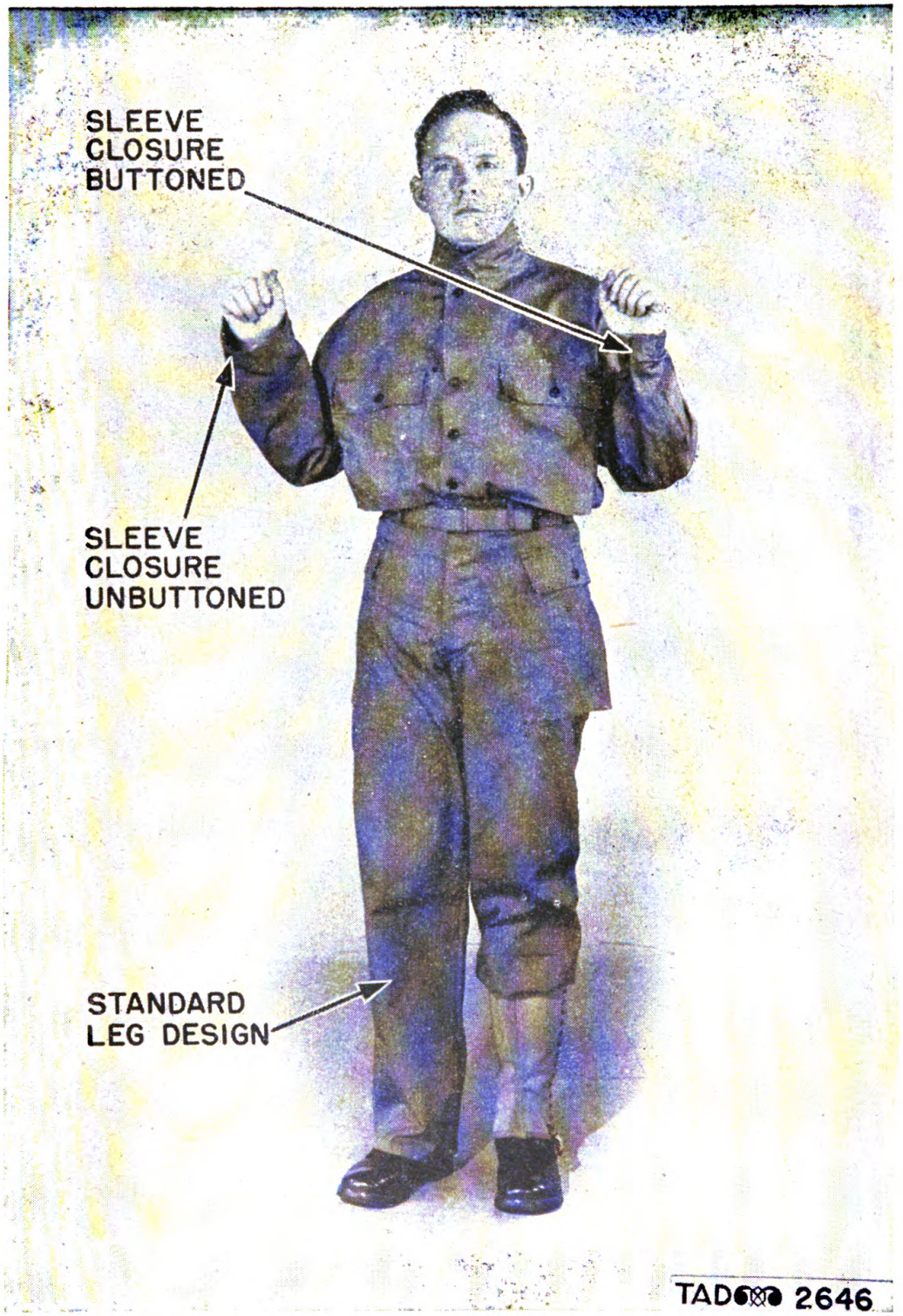

Figure 8. Suit, two-piece, herringbone twill, protective (jacket and trousers)

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Figure 9. Properly adjusted outfit, permeable type

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larger than the unimpregnated clothing. It is particularly important that sleeve length and collar size be adequate. The cotton gloves should overlap the sleeves by about 5 inches (fig. 10). As the neck is one of the more sensitive parts of the body, it is of the greatest importance that the neck closure be made properly. If a tight lining causes the hood to gape at the sides, stretch the hood lining (fig. 11). Resetting the top button will correct a loose fit around the sides if gaping is caused by a stretched buttonhole or by an improperly placed top button (fig. 12).

Figure 10. Putting on permeable protective gloves (cotton)

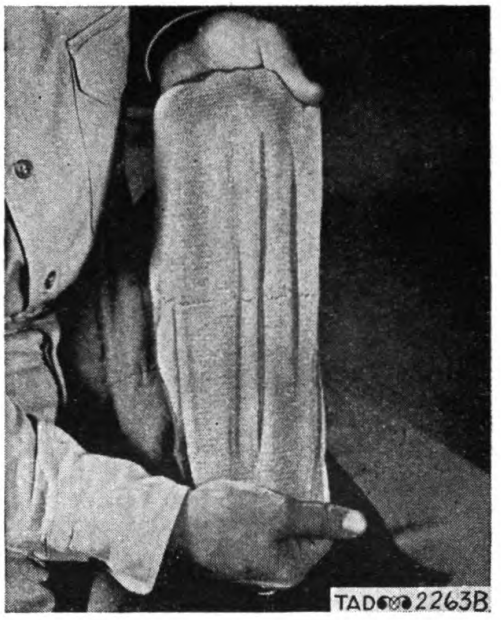

Figure 11. Stretching hood lining

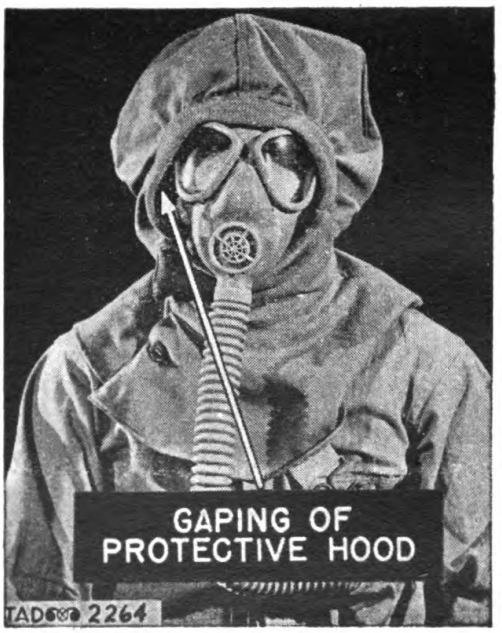

Figure 12. Gaping of hood

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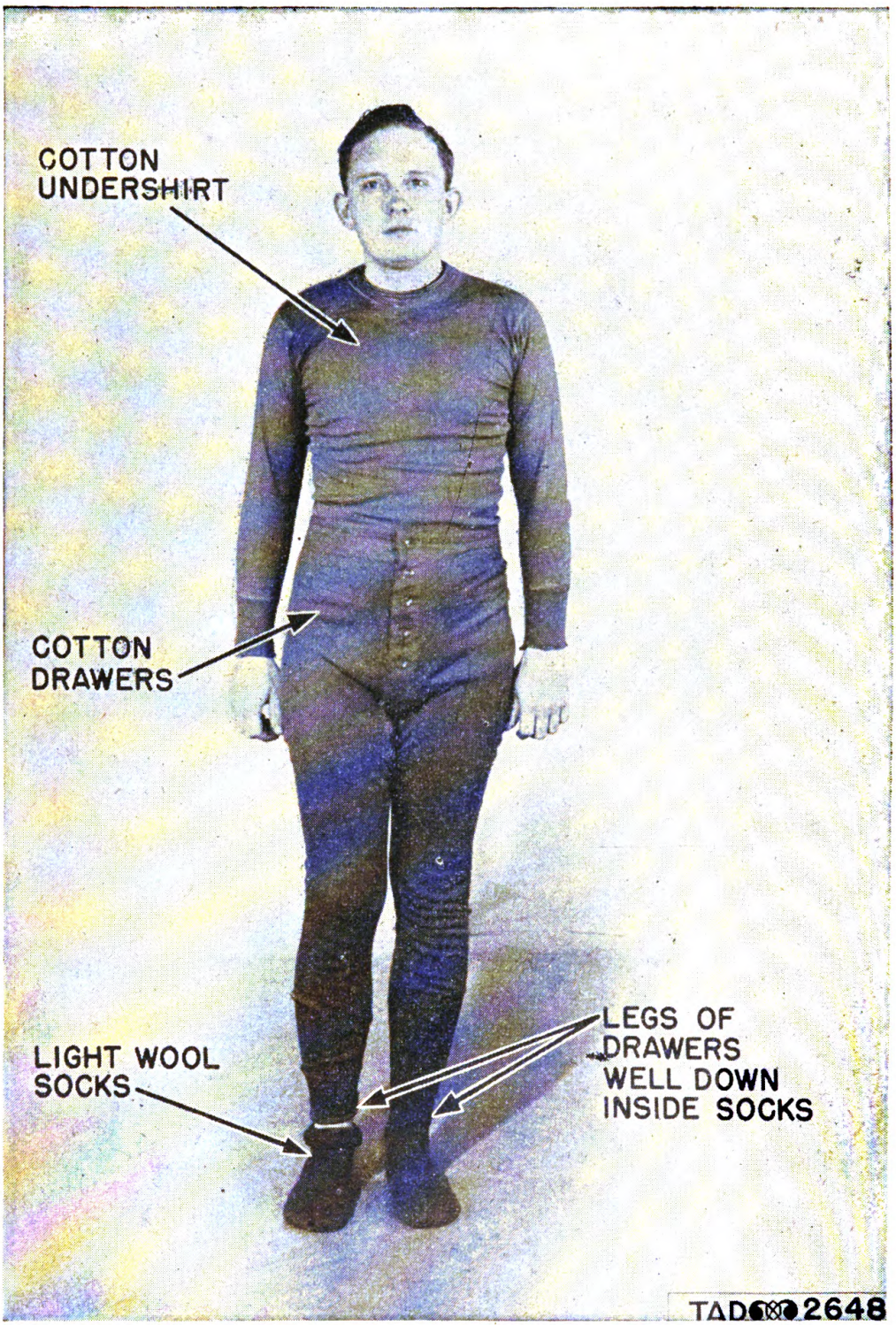

Figure 13. Protective underwear and socks (for men)

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11. DONNING. In general, permeable protective clothing is put on in the order in which the garments are listed in paragraph 9. (Gas mask and shoes, treated with shoe impregnite, are essential accessories.)

a. Underwear and socks (fig. 13). Take the following precautions in donning the underwear and socks:

(1) Tuck the lower part of the undershirt well down inside the drawers.

(2) Button the fly of the drawers completely.

(3) Pull up the tops of the socks tightly over the bottom of the legs of the drawers so that there will be a minimum of lumpiness.

b. Suit (one- or two-piece). Button the hood to the neckband of the one-piece suit or to the jacket or shirt of the two-piece suit and don the garment, allowing the hood to hang from the back of the collar (fig. 14).

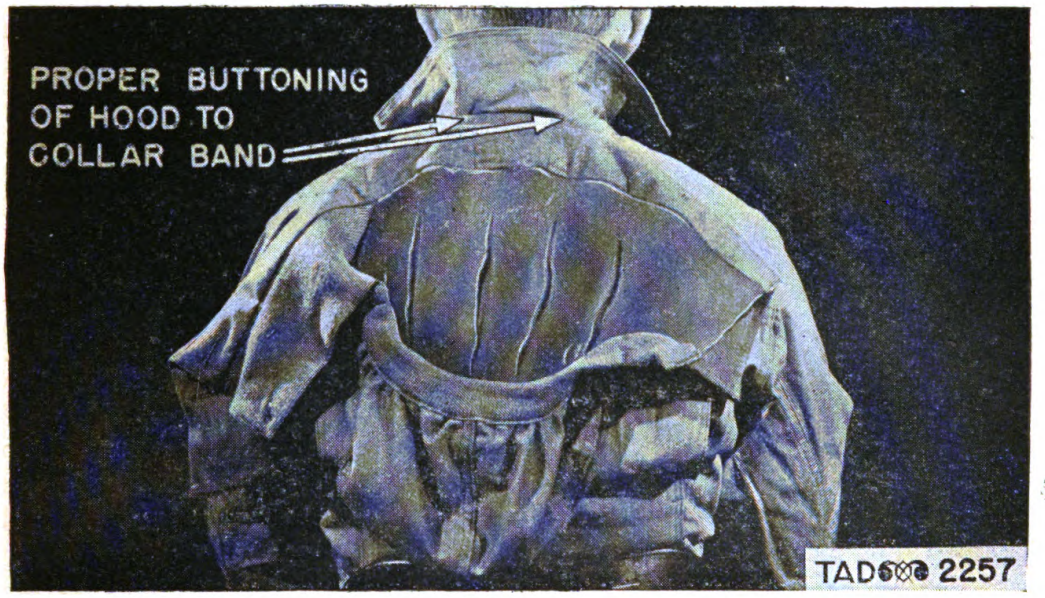

Figure 14. Hood attached to collar band

In the case of the two-piece suit the bottom of the shirt or jacket must be inserted inside the top of the trousers and held in place by the waistband. Wrap the sleeves around the wrists and the trouser legs around the ankles and fasten the buttons or straps. Where garments have no special fastenings, as in the case of certain shirts and trousers, the sleeves are held in place by the gloves, and the trousers by the leggings. In this case the sleeves and trousers are not wrapped until immediately before the gloves and leggings are adjusted.

c. Shoes. Put on shoes, previously treated with shoe impregnite (pars. 73 and 74), and lace.

d. Leggings. Don leggings in usual manner, being careful to obtain snug fit at the calves and shoe tops. In order to give maximum protection the leggings must be large enough to overlap the entire length of the laced closure.

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e. Gas mask. Put on the gas mask.

f. Hood. After the gas mask has been carefully adjusted, pull the hood over the head, allowing the edge to cover a portion of the eyepieces (fig. 15). Making sure the collar is still turned up and that it overlaps in front, grasp the lower edges of the hood's knitted binding and bring the right edge of the binding under the chin; lap the left edge over the right (fig. 16), and fasten the top button and two lower buttons. Figure 17 shows the hood correctly buttoned. Tuck binding of the hood back along the edge of the eyepieces (fig. 18). Figure 19 shows the hood correctly adjusted.

g. Gloves, permeable. Put on cotton gloves, pulling the wristlets over the sleeves of the suit or shirt.

Figure 15. Pulling hood over head

Figure 16. Right edge of binding under chin

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Figure 17. Hood correctly buttoned (before adjustment)

Figure 18. Binding of hood tucked around eyepiece

Figure 19. Hood correctly adjusted

12. UNDRESSING. Great care must be exercised in removing clothing which has been subjected to possible contamination. In large fixed installations a personnel decontamination station should be provided. Where these stations are not available the individual should be guided in the removal and handling of contaminated clothing and equipment by the methods outlined in the following paragraphs, to the extent permitted by the existing tactical situation.

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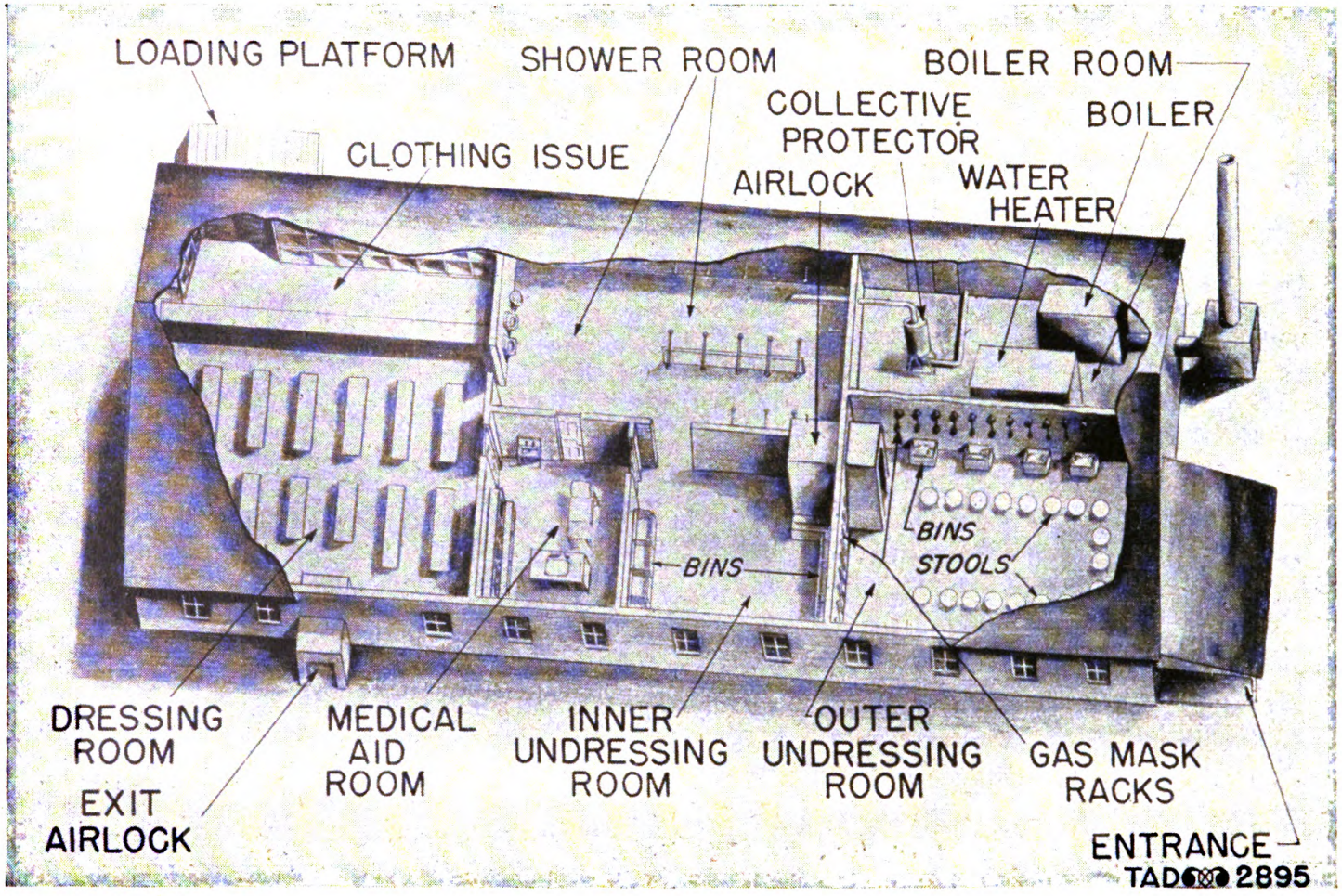

Figure 20. Personnel decontamination station

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13. PERSONNEL DECONTAMINATION STATION. a. Arrangement and procedure. Figure 20 shows the arrangement of a personnel decontamination station suitable for a large fixed installation. At the entrance of the station, if the situation permits, brooms or brushes and water should be available to remove contaminated mud which might be on the shoes. On entering the station, personnel remove rubber gloves (if worn), hoods, gas masks, outer clothing, and then boots or shoes, depositing them in the appropriate bins. After removing the aforementioned items personnel seat themselves on the stools provided and swing their bodies around (facing the center of the room) so that their feet can rest on the clean, uncontaminated paper spread on the floor. Finally, just before passing through the airlock into the inner undressing room, the fabric gloves are removed. In the inner undressing room personnel remove the remainder of their clothing. Bins are provided into which the various items of clothing and equipment are put as they are removed. Personnel bathe thoroughly in the shower room, using warm water and plenty of soap, are examined by medical personnel, and given medical treatment if required. Personnel then proceed to the dressing room where clean clothing and equipment is provided on an exchange basis for that which was removed before bathing. An airlock is provided at the exit from the station. A collective protector is used to introduce pure air into the medical aid and dressing rooms of the station and from these rooms this air circulates through the other gasproof rooms. TM 3–350 should be consulted for details regarding gasproofing of buildings and installation of collective protectors.

b. Handling contaminated garments and equipment. Personnel handling contaminated clothing or other equipment must wear permeable protective clothing, plus gas mask, rubber gloves (if available), and shoes treated with shoe impregnite. Garments (contaminated) to be laundered must be inclosed in airtight bags, gas-resistant sacks, or tightly covered G.I. cans, and sent immediately to the designated quartermaster laundry. Underwear removed in the personnel decontamination station usually will not be heavily contaminated, if at all. Nevertheless it must be handled with care. Laundered permeable protective clothing will be reimpregnated by a chemical processing company and returned to the Quartermaster Corps for reissue. Other contaminated items will be decontaminated, or destroyed if necessary, by decontamination station personnel.

c. Details of operation of personnel decontamination stations. These details, including manner of replenishment of stocks of clean clothing and equipment, will be determined in accordance with the prevailing situation in each case.

14. LAUNDERING. Impregnated clothing should be laundered by use of Quartermaster Corps standard washing formula "G." This formula is

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for wool washing, utilizing mild soap and water at a temperature of 90° F. By the proper use of this formula, impregnated clothing may be laundered approximately four times before requiring reimpregnation. High water temperatures and strong soaps and alkalies will destroy the protective agent which necessitates water of 90° F. and the use of mild soap.

15. STORAGE. a. Conditions of storage. (1) Moisture, high temperature, and light (especially direct sunlight) have an adverse effect on the storage life of impregnated clothing. Chemical and quartermaster officers should see, therefore, that such clothing is stored in the coolest, driest place available and protected from direct sunlight. If practicable, the buildings in which it is stored should be ventilated. The same precautions apply to storage of materials provided for impregnation of clothing. (2) Mothproofing agents must not be used on impregnated clothing. Woolen clothing which has been treated with mothproofing compounds should not be impregnated except where camphor or naphthalene has been employed and then only after thorough aeration.

b. Deterioration in storage. Even under the best storage conditions, permeable protective clothing loses its impregnite content gradually. In the case of cotton garments, there is a simultaneous loss of tensile strength which may be sufficient to render them unfit for reimpregnation. In clothing consisting of wool-cotton mixtures, the loss of strength is usually much less serious than in cotton clothing. The strength of impregnated woolen garments is not substantially affected by storage and they may usually be made serviceable merely by reimpregnation. Impregnated clothing deteriorates more rapidly in tropical climates than in temperate zones. In tropical climates, therefore, stocks of impregnated clothing must be kept to the minimum, and reliance placed upon impregnating garments as the need arises. Both stored clothing and clothing in use must be inspected periodically (par. 17). *Caution:* So far as possible, do not allow deteriorated garments to be in contact with serviceable garments for any length of time since the garments which have lost their impregnite content initiate and accelerate deterioration in the serviceable clothing.

16. SHIPMENT. In shipping impregnated clothing, the conditions mentioned above for storage (par. 15) should be maintained as far as practicable. The coolest, driest, available space should be selected for shipping. Hot bulkheads and compartments, as well as spaces containing chemicals such as gasoline or other materials whose vapors might injure clothing, must be avoided. Shipment may be made in bales and also in wooden boxes lined with duplex waterproof paper, with the individual bundles wrapped in kraft paper. Clothing in bales is protected by kraft paper and duplex waterproof paper. The method of packing should exclude moisture and light to the maximum practicable degree.

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17. INSPECTION. a. Stored impregnated clothing. (1) GENERAL. Officers in charge of impregnated clothing in storage will be responsible for maintenance of the best practicable storage conditions and will not issue such clothing until the impregnite content, color, tensile strength, and condition of fasteners on the clothing have been shown to be satisfactory as indicated below.

(2) EXAMINATION AND TEST. (*a*) *General.* Periodic tests for impregnite content and tensile strength and careful visual examination particularly of the condition of the fasteners and color changes in the garments are necessary to insure that the clothing is maintained in good condition. For this purpose, at least one-half of 1 percent of the garments in storage and 1 percent of those taken from storage for wearing will be tested according to the following schedule: In the Tropics, every month; in temperate and cold climates, 3 months after impregnation and every 3 months thereafter. Officers in charge will determine that the garments taken for visual examination and test are truly representative of the clothing in their custody. One sample should be taken from *each end* of the bale or box of clothing and one sample from *the center* of the bale or box.

(*b*) *Visual examination.* The selected garments will be examined carefully for holes, tears, localized or general discoloration, general fading, particularly for *looseness* and *corrosion* of buttons and buckles, and the condition of the cloth in contact with the fasteners, also for any other conditions which might render the clothing unsuitable for protective purposes, including tenderizing of the fabric in the vicinity of the fasteners or over large areas. All test clothing will then be subjected to the test for tensile strength and impregnite content.

(*c*) *Thumb test for tensile strength.* The following test will be used to determine the mechanical strength of the fabrics:

1. Grasp a single thickness of the cloth between the thumbs and forefingers (fig. 21).
2. Hold the cloth horizontally so that the thumb tips touch each other.
3. Holding the cloth tightly, rotate the hands inward, until the upper surfaces of the thumbnails are together, thus exerting a pressure on the surface of the cloth.
4. It is suggested that at least three thumb tests be made in each of the lengthwise and crosswise directions of each test garment, selecting as test sections areas where there is discoloration, areas around the fasteners, or areas where fasteners are in contact with the fabric.

(*d*) *Test for impregnite content.* Directions and details for this test are found in chapter 4.

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b. Issued clothing. (1) GENERAL. Officers in charge of clothing will be responsible for keeping issued clothing in good condition, making the necessary inspections and tests of the issued clothing and will maintain such records as are necessary to accomplish this purpose. It is important that troops understand that impregnated clothing should not be ironed, and must not be dry-cleaned. Clothing that has been dry-cleaned has no protective value, and must be reimpregnated. Garments that are torn, ripped, lack buttons, or are otherwise damaged will give only partial protection and should be repaired if their general condition warrants it. Failure of garments to fit well means poor closures and inadequate protection. Such clothing should be returned to the issuing office in exchange for clothing that fits properly (par. 10).

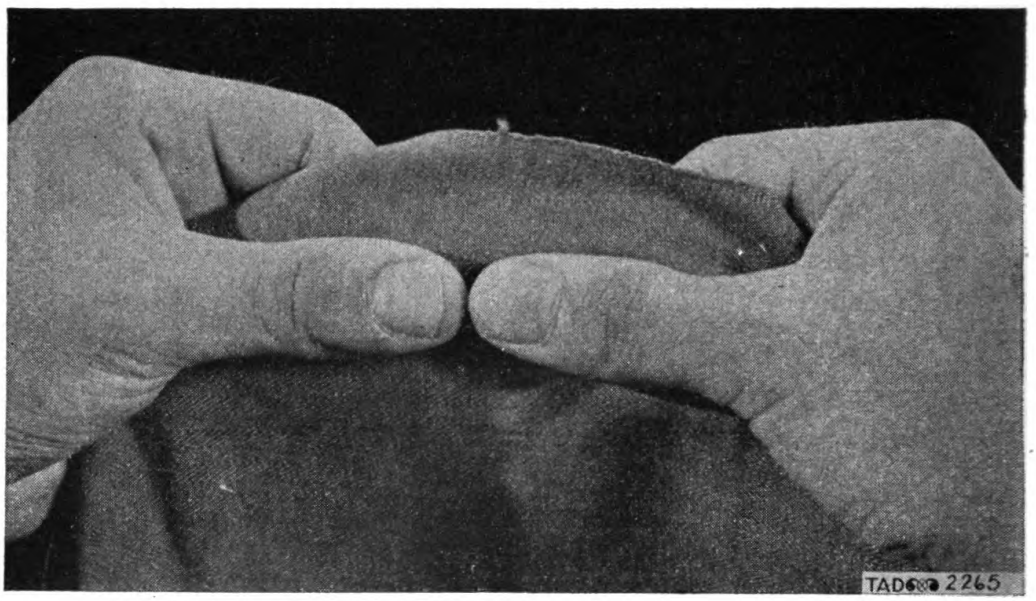

Figure 21. Grasping single thickness of cloth at beginning of test for tensile strength

(2) EXAMINATION AND TEST. (*a*) When protective clothing is being worn by troops, but has not been contaminated by blister gases, 10 percent of all clothing in service will be inspected and tested periodically for general wear, impregnite content and tensile strength, in accordance with the following schedule:

1. In tropical, semitropical, and warm temperate climates, outer clothing, under clothing, and leggings will be tested after 2 weeks' wear and one laundering.
2. In arctic, subarctic, and cold temperate climates, outer clothing and leggings will be tested after 4 weeks' wear and two launderings.

(*b*) For clothing that has been contaminated see paragraphs 12 and 13.

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18. INTERPRETATION OF INSPECTION-TEST RESULTS. a. Visual examination. Small tears, holes, and missing buttons revealed during examination usually indicate deterioration of the garment fabric. Localized discoloration generally indicates fabric tenderizing and is caused in most instances by contact with deteriorated clothing or with metal fasteners, which initiates and accelerates this condition. The extent of this tenderizing will be revealed by the readiness with which the fabric tears when subjected to the thumb test. General discoloration or fading of impregnated garments is influenced by the finishing treatments given to cloth prior to its fabrication into garments.

b. Tensile strength. Tears caused by the thumb test (fig. 22) in any of the sections tested will be cause for rejection of the garment. Disclosure of low mechanical strength in two of the three test garments from each representative bale or box will be cause for classification of the clothing represented by the test garments as unserviceable.

c. Impregnite content. Obtaining a negative result in any of the sections tested with the kit for testing impregnite in clothing will be reason for reimpregnation of the garment.

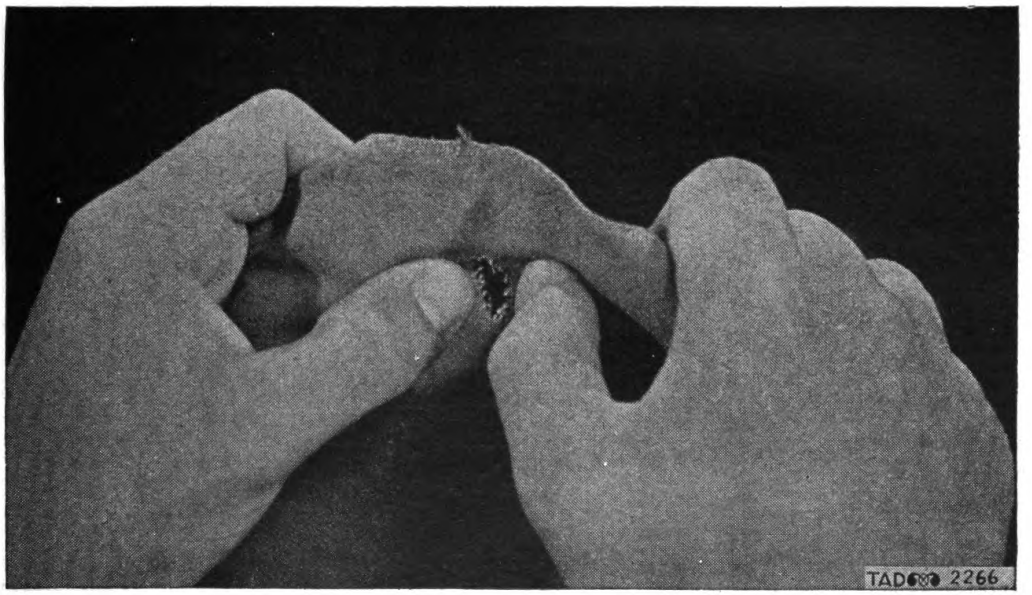

Figure 22. Tear resulting from thumb test for tensile strength

19. DISPOSITION OF GARMENTS. a. Garments which are physically defective only (holes, tears, loose buttons, etc.) will be replaced if their general condition warrants.

b. Garments which are faded or discolored but otherwise serviceable will be redyed with pigments in the impregnating bath.

c. Garments low in impregnite content but otherwise satisfactory will be reimpregnated.

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d. Garments which are both physically defective and low in impregnite content will be repaired first, then reimpregnated.

e. Garments which are easily torn by the thumb test or otherwise unsuitable for protective purposes will be disposed of and replaced with new impregnated garments.

f. Garments withdrawn from storage for test purposes will be replaced in the bales after testing. If found satisfactory the bale will be left in storage. If for any reason the above tests have shown the clothing to be unsatisfactory, the bale will be removed and proper disposition made of the clothing, depending on the results of the tests.

SECTION III
PERMEABLE PROTECTIVE CLOTHING FOR WOMEN

20. GENERAL. Protective clothing for women is of the permeable type similar to permeable protective clothing for men, differing only in modification of design and dimensions.

21. ITEMS (fig. 23). Following are the items comprising protective clothing for women:

1 *undershirt, cotton, women's protective.*
1 pair *drawers, cotton, women's protective.*
1 pair *socks, wool, light, protective.*
1 *suit, cotton, one-piece, herringbone twill, nurses', protective,* or
1 *shirt, herringbone twill, women's, protective,* and one *trousers, herringbone twill, women's, protective.*
1 *hood, wool, protective.*
1 pair *leggings, canvas, women's, protective.*
1 pair *gloves, cotton, women's, protective.*

22. DONNING. Garments are put on in order of listing. (Gas mask and shoes, treated with shoe impregnite, are essential accessories.)

a. Underwear and socks. Don underwear and socks, using the following precautions in their adjustment:

(1) Tuck the lower part of the undershirt well down inside the drawers.
(2) Pull up the tops of the socks over the bottoms of the legs of the drawers in order that there will be a minimum of lumpiness at the overlap of the socks and drawers.

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b. Suit (one- or two-piece). Button the hood to the neckband of the shirt (or suit, one-piece), allowing the hood to hang down from the back of the collar. Put on the shirt, then the trousers, and push the bottom of the shirt inside the trousers. Button the sleeve closure (fig. 6).

c. Other items. Proceed as outlined in paragraph 11c, d, e, f, and g (fig. 24).

Figure 23. Properly adjusted outfit, permeable, protective (for women)

Figure 24. Protective clothing for women

23. STORAGE AND SHIPMENT. The best general conditions are as outlined for permeable protective clothing for men (pars. 15 and 16).

24. INSPECTION AND MAINTENANCE. Inspection and maintenance are carried out as described in paragraph 17.

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SECTION IV
IMPERMEABLE PROTECTIVE CLOTHING

25. GENERAL. Impermeable protective clothing is apparel (fig. 1) which does not require impregnation to make it protective. It is made of materials normally resistant or impervious to blister gas and is issued in small quantities by the Quartermaster Corps.

26. USE. a. The set of clothing described in paragraph 27 may be worn for limited periods of time only, particularly in warm, humid weather. This is because the impermeable outer garments retard normal evaporation of moisture from the body surface. The following periods of wear at the indicated temperatures accordingly have been suggested when men are engaged in moderate activity:

Temperature (°F.)	Time of wearing without ventilation of the body (hrs.)
Above 90°	¼
85–90	½
80–85	1
70–80	1½
60–70	2
50–60	3
30–50	5
Below 30	8

b. Because of the discomfort and loss of efficiency which accompany the wearing of impermeable clothing, this apparel is not used in combat. It is most effectively employed in extremely hazardous decontamination jobs or other operations involving danger from spillage or splashes in the handling of large quantities of liquid blister gas.

27. DESCRIPTION. A suit of impermeable type protective clothing consists of a one-piece working garment of impermeable material with an attached hood of the same fabric. Under this suit impregnated underclothing is worn. The foot covering consists of impregnated socks and shoes, treated with shoe impregnite. Impermeable rubber gloves and a gas mask are also worn. Cotton protective gloves are worn under the rubber gloves.

28. DONNING. a. Underwear and socks (fig. 25). Proceed as outlined in paragraph 11.

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Figure 25. Impermeable type protective clothing (for men)

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b. Suit. Proceed as outlined in paragraph 11. When the suit is on, adjust the wrist closure to obtain snug fit (fig. 26). Put on and lace shoes, draw suit legs down over the shoe tops, tighten, and tie the draw-

Figure 26. Sleeve and glove adjustment with impermeable protective suit (for men)

Figure 27. Leg-ties adjusted

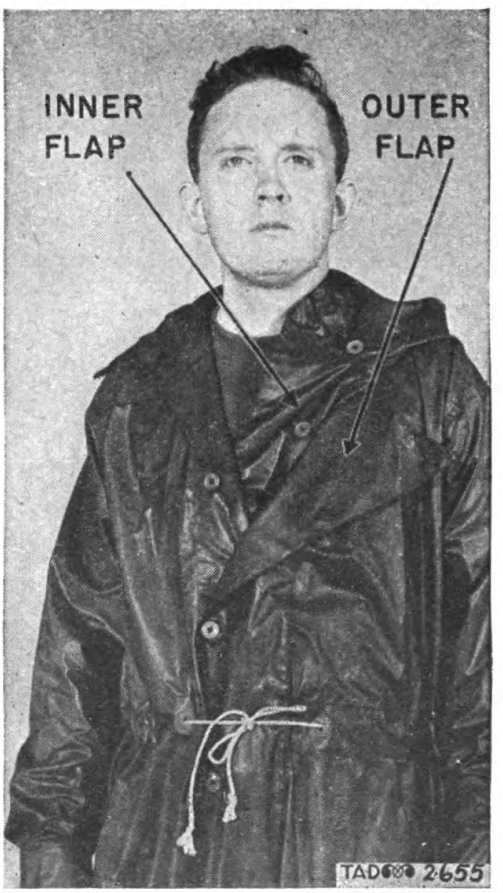

Figure 28. Inner and outer flaps on impermeable suit

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Figure 29. Oilskin type impermeable suit (old style)

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strings (fig. 27). Button the double closure of the suit, except the last two buttons. Tighten and tie waist drawstring (fig. 28). (Complete the closure after the gas mask has been adjusted.)

NOTE: Older models of the suit may have adjustable straps at the wrists and ankles, and slide fasteners instead of buttons on the front of the suit (fig. 29). Adjustment and closure is made as for the later model.

c. Gas mask. Put on the gas mask.

d. Hood. The hood is part of the impermeable suit. Proceed as described in paragraph 11 with the following exceptions:

(1) Draw the under flap of the closure from left to right and button the two buttons at the chin and throat (fig. 30).

(2) Pull outer flap from right to left, tighten, and tie drawstrings at left side of gas mask facepiece (fig. 31).

Figure 30. Inner flaps of impermeable hood

Figure 31. Impermeable hood adjusted

e. Gloves. (1) PERMEABLE. Proceed as outlined in paragraph 11.

(2) IMPERMEABLE. Put on impermeable gloves over the cotton gloves. The impermeable gloves are designed to be worn for protection against liquid blister gas or other corrosive chemicals in quantities greater than droplets. Cotton gloves (protective) are sufficient protection against blister gas vapors or droplets.

29. STORAGE AND SHIPMENT. a. Ideal storage and shipping conditions are the same as those for permeable protective clothing (pars. 15 and 16), that is, the coolest, driest place available should be selected.

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b. In the case of the one-piece impermeable protective suit, it should be emphasized that if only a few garments are to be stored, their usefulness will be prolonged greatly by placing each garment on a nonmetal coat hanger and arranging them in a manner which permits free circulation of air around each.

30. INSPECTION. a. General. Impermeable equipment in storage and in use must be inspected periodically to insure maintenance in good condition. Five percent of the garments in use and 1 percent of those in storage will be inspected each month in tropical climates, and the same percentages every 3 months in temperate and cold climates. A larger percentage of the garments may be taken for test in any case where the required percentage is judged to result in inadequate sampling.

b. Suit, protective, one-piece, impermeable (coverall). These suits will be inspected visually for excessive mildew, stickiness, holes, tears, stiffness, and any other condition which would render them unsuitable for protective purposes. Garments which are heavily mildewed or so sticky that they cannot be unfolded readily will be discarded. Holes and tears will usually be considered sufficient reason for discarding, as means of repair are generally lacking in the field. If garments can be repaired they should be salvaged. In an emergency, small tears and cracks may be covered with adhesive tape, but this is only a temporary expedient to serve until new garments are obtained. Coveralls made of fabrics which crack or are too stiff to wear at prevailing low temperatures also will be discarded.

c. Gloves, impermeable (rubber). The gloves will be examined for imperfections including stiffness, tackiness, checking, tears, holes, excessive wear, or other defects which would render them unsuitable for protective purposes.

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CHAPTER 3

FIELD IMPREGNATION (FIELD IMPREGNATING SET)

31. PURPOSE. The method described in this chapter is used by Army personnel when protective clothing is not available through the Quartermaster Corps and when it is likely that such clothing will be needed for protection against blister gases.

32. PROCESS. a. The process, which employs the field impregnating set, is a water suspension method.

b. The *set, impregnating field, M1* may be used by troops under the direction of their commissioned and noncommissioned officers.

(1) The set is suitable for impregnating either regular issue untreated clothing or impregnated clothing which requires reimpregnation. It is used for shirts, trousers, socks, underwear, hoods, coveralls, leggings, fabric gloves, and all other cotton or woolen garments. Impregnation of *field jackets* (or any garment utilizing slide fasteners), *raincoats,* and *special impermeable oilskin,* or *rubber garments,* will not be attempted.

(2) Clothing recently treated according to instructions with the field impregnating set will give reasonably safe protection against blister gases in the form of vapor and droplets. The impregnite in such garments neutralizes the blister gas.

33. DESCRIPTION. a. Packaging. Component parts of the field impregnating set M1, are packed in a plywood shipping box outside dimensions of which are approximately 27⅞ inches by 13⅜ inches by 13⅜ inches. Displacement is approximately 2.7 cubic feet. Gross weight of box and contents is approximately 80 pounds.

b. Contents of box. Each set (fig. 32) includes the following:

1 illustrated directions card.
1 collapsible, waterproof, canvas mixing bag. (A clean, *dry* 55-gallon drum may be substituted for the canvas bag.)
1 wooden top stave, reinforcing ring, or hoop for top of bag.

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4 wooden side staves for bag.
1 wooden mixing paddle (in two pieces).
2 $\frac{3}{16}$-inch bolts, wing nuts, and washers, for assembling paddle.
1 package No. 1 (5-gallon can), containing active protective agent and stabilizer.
1 package No. 2 containing dispersing agent stabilizer, wetting agent, and a package of dye.
1 package No. 3 (2-gallon metal pail), containing binder.
2 containers for measuring water. (This consists of two parts of package No. 1.)
100 feet ¼-inch rope, to be used as clothesline.

c. Locally obtained items. (1) WATER. Approximately 23 U. S. gallons of water are required for use with the set and should be the cleanest available. Salt water may be used, although it is not as suitable as fresh.

(2) STAKES. Improvised wooden stakes may be cut for holding down the four loops at the base of the mixing bag. They should be about the size of shelter tent pins. If stakes cannot be provided, personnel may use their feet to hold down the loops.

34. CAPACITY. One set contains 24 pounds of active agent, sufficient to impregnate 25 to 30 outfits of clothing consisting of the following garments:

25 to 30 coveralls (or 25 to 30 woolen shirts and 25 to 30 pairs woolen trousers).
25 to 30 undershirts, special.
25 to 30 pairs drawers, special.
25 to 30 hoods.
25 to 30 pairs socks.
25 to 30 pairs leggings.
25 to 30 pairs fabric gloves.

Ordinary woolen or cotton drawers, shorts, or undershirts may be substituted for the special undershirts and drawers and will give fairly satisfactory protection. Other combinations of garments, in addition to those listed above, also may be impregnated. It is advisable, however, that personnel subjected to blister gases wear two thicknesses of impregnated clothing, that is, outer garments and underwear.

35. PERSONNEL REQUIRED. A minimum of three men should be assigned the task of setting up and using each set. The vigorous stirring required will make it necessary for them to relieve each other at short intervals.

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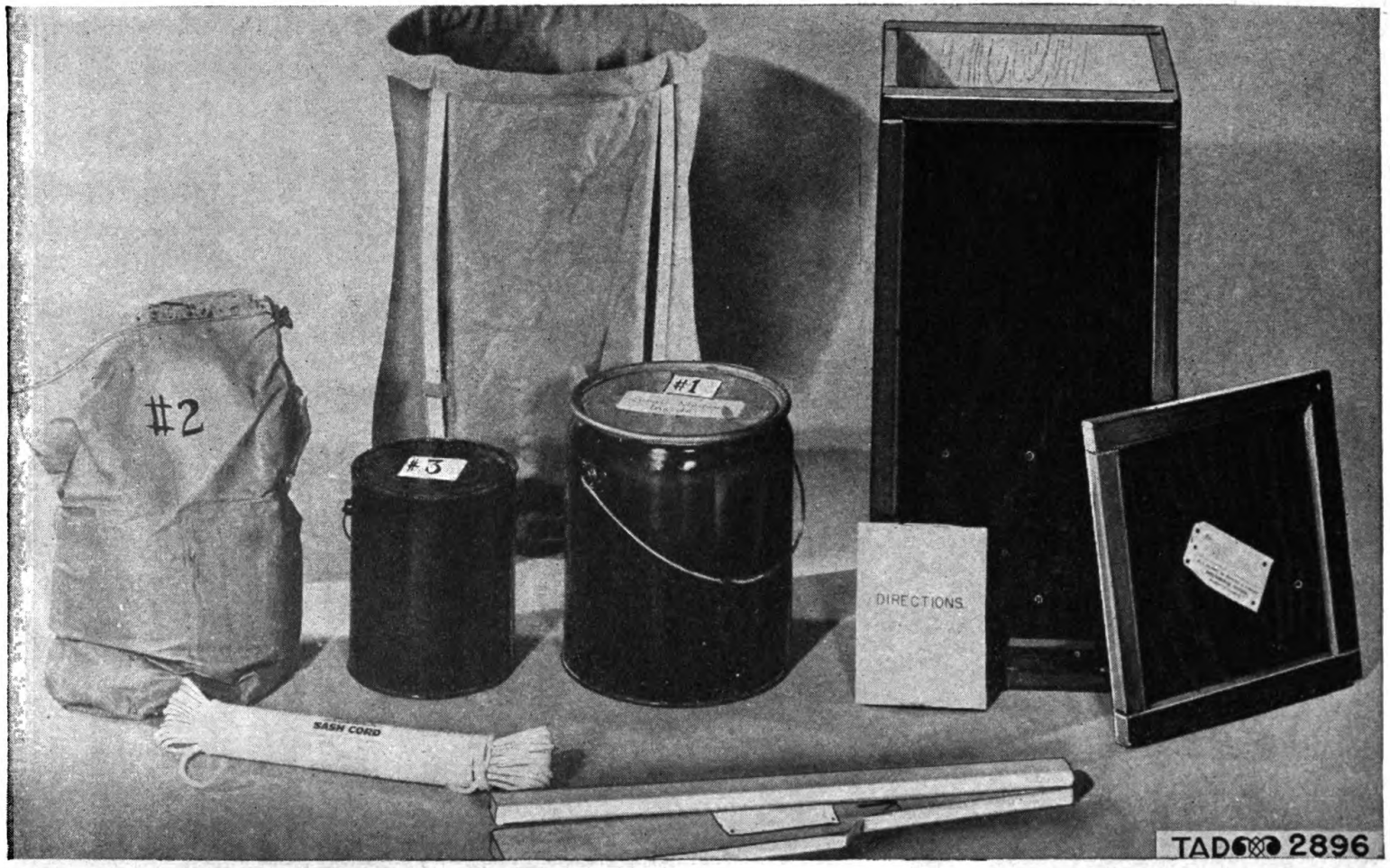

Figure 32. Contents of field impregnating set M1

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36. TRAINING. Before attempting to use the set, all personnel involved should read the directions card contained in the box and understand each step. No attemp should be made to shorten the procedure or to use only a part of the materials supplied in the set.

37. TEMPERATURES AND STORAGE. The set and materials should be kept cooler than 150° F. and should not be stored in direct sunlight. Temperature as low as 32° F. is satisfactory in preparing the mix.

38. SELECTION OF SITE. The site selected for the operation should provide ample space for spreading or hanging the clothing to dry. The clothing should *not* be exposed to sunlight during drying because direct rays of the sun hasten fading and discoloration of the clothing due to decomposition of the active agent. The actual operation of impregnation may be carried out either in the open or indoors.

39. ASSEMBLING THE APPARATUS. a. Paddle. Place the two parts of the paddle so that the two drilled holes in each overlap. Insert

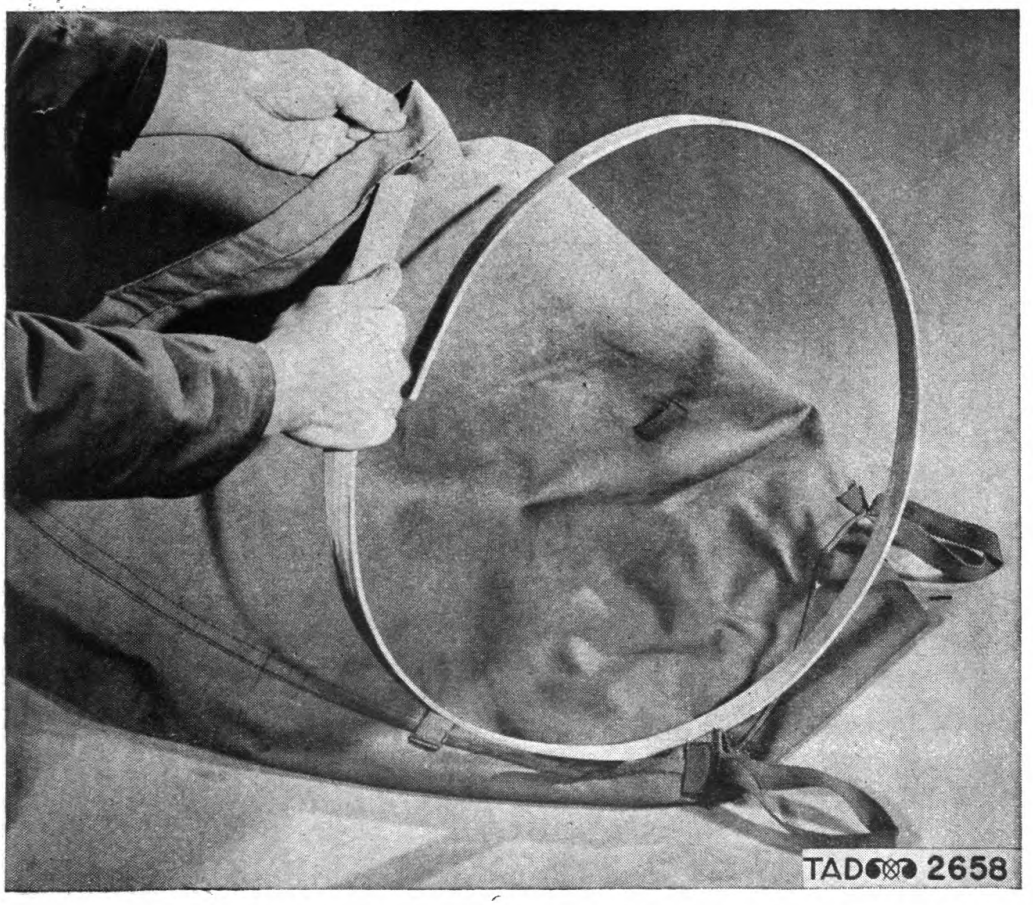

Figure 33. Inserting reinforcing ring

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bolts through holes, place washers and wing nuts on bolts, and screw tight so that the paddle becomes a rigid unit. If, for any reason, the paddle is broken or lost, an improvised paddle may be made.

b. Canvas mixing bag. (1) Insert the wooden reinforcing ring, or hoop, into the top rim of the canvas, or bag, as shown in figure 33. (2) Insert each of the four wooden staves into the slots at the top, side, and bottom of the bag (fig. 34). It may be found necessary to bend or flex them somewhat before they slide into position.

Figure 34. Inserting staves in bag

(3) For use, place the bag on level ground to prevent tipping.
(4) Drive improvised stakes into the ground through each of the four canvas foot tabs or loops at the base of the bag (fig. 35). If stakes cannot be obtained, personnel stirring the mix can place their feet through the tabs to steady the bag (fig. 36).

40. PREPARING THE MIX. a. Empty package No. 1 into the mixing bag and then sprinkle in contents of package No. 2 (excepting the dye).

b. Mix the dry powders by stirring briskly for *2 minutes.*

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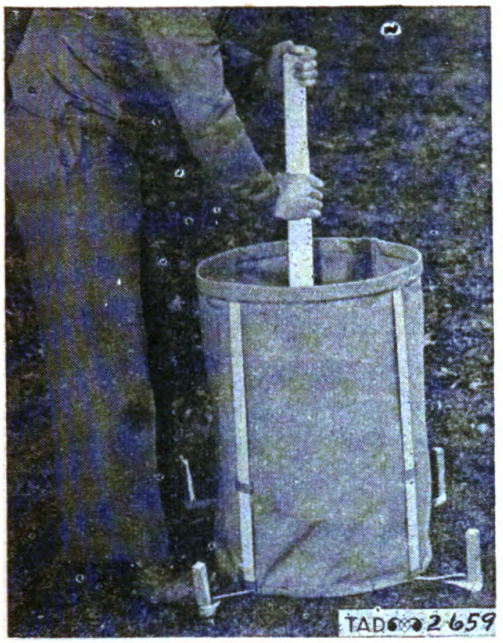

Figure 35. Anchoring bag with stakes

Figure 36. Anchoring bag with feet

Figure 37. Adding small container of water to drum

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c. Add 2 *small* containers of water (fig. 37) and stir the contents of the mixing bag briskly for 15 minutes or until all the lumps are gone. The paste must be thick and smooth (fig. 38).

d. Add the entire contents of package No. 3. Stir the thick paste brickly for *20 minutes.*

e. Fill the large container with water and add dye from package No. 2. Stir until the lumps are dissolved. Add the mixture slowly to the thick paste in the mixing bag while stirring briskly. Stir in three more *large* containers of water (fig. 39).

f. Keep the mix stirred and use at once.

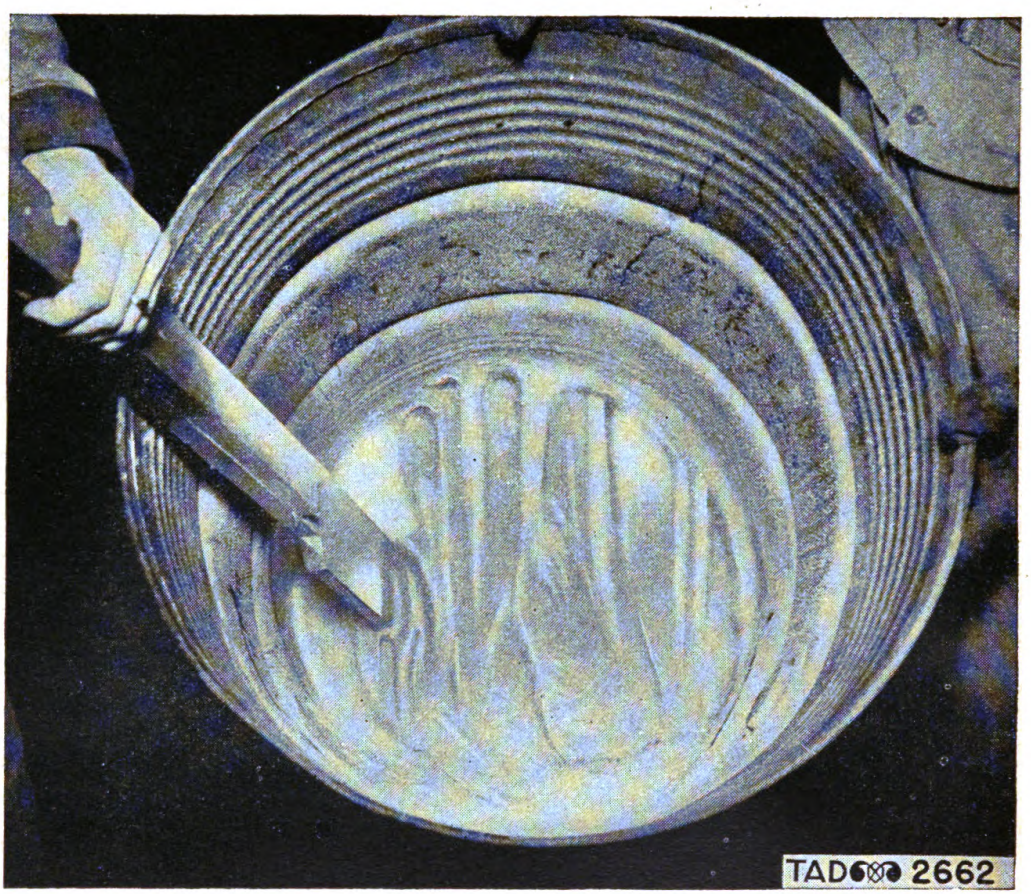

Figure 38. Mix stirred to smooth paste

41. TREATING THE GARMENTS. **a.** Clothing should be clean. It will be impregnated as soon as possible after preparation of the mix. The mix loses strength if allowed to stand. It should also be stirred vigorously for *5 to 10 minutes immediately before using.*

b. Large garments should be treated first, socks and gloves last. (1) Immerse and knead the clothing until it is thoroughly wet throughout. Wring out and repeat three times before final immersion. Pockets will be wetted more easily if turned inside out.

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(2) *After final immersion, wring out each garment just enough to prevent it from dripping when hung on the line.* Excess mix should be caught in the mixing bag while wringing the clothes (fig. 40). Garments which have been laundered often absorb more of the impregnating chemicals than new clothing. (Thus it may be necessary to wring out more of the solution in order to keep the active agent content within the desired limits.) To obtain adequate protection, the garment should approximately double its weight by absorption of mix. When scales are available a few garments may be weighed. If the wet garments do not weigh at least twice as much as before impregnation, they are being wrung too dry.

Figure 39. Adding large container of water to drum

(3) Hang the clothing up to dry, avoiding direct sunlight (fig. 41). All wrinkles should be smoothed out while the clothing is wet as they give a streaked appearance in the dried clothing (fig. 42).

(4) Using a brush or the hand, remove any small lumps of mix which may have been deposited on the wet clothing (fig. 43). Lumps should be removed before they dry. (If salt water is used in the mix, however, the garments must be hung up immediately after wringing and *no attempt should be made to smooth out lumps.* The high salt content renders the mix on the garments unstable after exposure to the air. Rubbing will produce smearing and possible removal of mix from the garment.) The dried clothing should be folded and stored in a cool, dark place until issued. Do not iron or press, as this tends to render the fabric less protective.

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42. UTILIZING IMPROPERLY PREPARED MIX. If directions have not been followed, the mix may be lumpy or nonuniform. Sometimes such a mix may be made usable by one of the following methods:

a. Lumps. Do not attempt to impregnate clothing until the mix is *entirely free* of lumps. Lumps arise either from improper blending of binder or improper blending of the protective agent. In either case the lumps may be removed by stirring the mix every 5 minutes until they are eliminated. This may take from ½ hour to 2 hours. In an emergency the lumps may be removed by skimming or straining the mix through cheesecloth or mosquito netting. This procedure, however, reduces the value of the mix in direct ration to the quantity of lumps removed.

b. Oily mix. A large amount of unblended binder may be discovered after dilution of the mix if warm sea water has been used. This will cause the impregnated clothing to be excessively oily, especially if it is pushed to the bottom of the mixing bag. It is impossible to blend the binder after the mix has been diluted. Only in an emergency should such a mix be used and it should be borne in mind that the treated clothing will give protection only as long as the garments are not immersed in water.

Figure 40. Wringing clothes over drum

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Figure 41. Hanging clothes in shade

Figure 42. Smoothing out wrinkles

Figure 43. Removing unabsorbed lumps

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CHAPTER 4

KIT FOR TESTING IMPREGNITE IN CLOTHING

SECTION I
GENERAL

43. PURPOSE. The *kit, testing, impregnite in clothing, M1* provides a method for determining when impregnated clothing no longer affords adequate protection against blister gas vapors or droplets. The test can be used in the field as well as for clothing in storage or at laundry installations.

44. DESCRIPTION. The complete test kit (fig. 44) consists of an olive drab, cotton duck kit, 6½ inches wide, 4½ inches high, and approximately 1-inch thick. It weighs about 1 pound. Two loops for attachment to the waist belt are provided.

45. CONTENTS. The contents of the kit (figs. 45 and 46) comprise the following:

Solvent, in 1-ounce bottle (bottle A).
One heavy glass eye dropper for solvent.
One 1-ounce bottle (bottle B) with eye dropper. The bottle contains two white tablets, which, when dissolved in water (par. 46) comprise the test solution.
One 1-ounce bottle (bottle C) with eye dropper. The bottle contains two light orange-colored tablets, which, when dissolved in water (par. 46) comprise the neutralizing solution.
Book of test papers.
Soft, black pencil for marking spots on garments.
Instructions card with complete directions for test.

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Figure 44. Kit, testing, impregnite in clothing, M1 (closed)

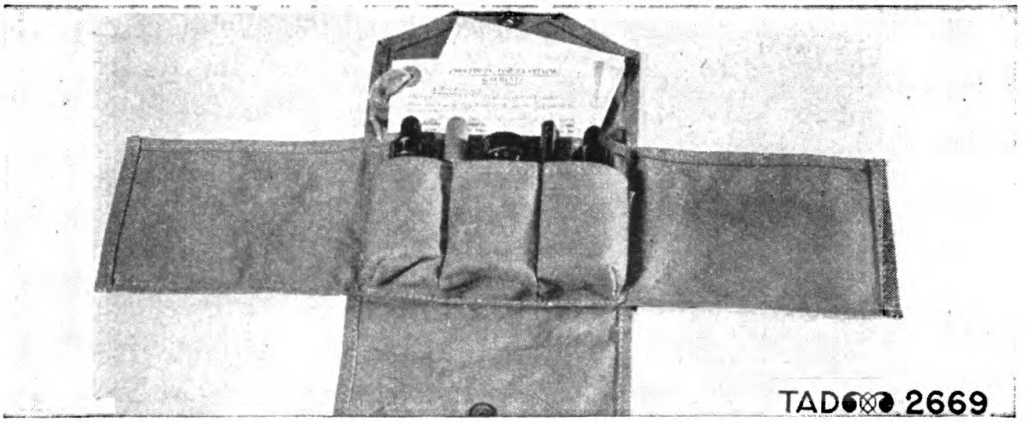

Figure 45. Kit, testing, impregnite in clothing (open)

Figure 46. Kit, testing, impregnite in clothing (open)

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SECTION II
TEST PROCEDURE

46. PREPARING SOLUTIONS AND TESTING. a. Preparation of solutions. When the kit is to be issued from the depot, the bottles containing the tablets (bottles B and C) will be filled with clean rain water, well water, or preferably distilled water (never chlorinated water) to within about ¼-inch of the lower part of the neck of the bottle, and the bottle rotated or shaken until the tablets are dissolved. The neutralizing solution tablets are colored with dye to distinguish them from the test solution tablets. The dye colors the neutralizing solution a greenish-yellow which serves to distinguish this solution from the test solution.

b. Test procedure. (1) Place one drop of solvent (bottle A) on the cloth to be tested.

(2) Place one drop of test solution (bottle B) on the spot wet by the solvent.

(3) After 2 or 3 seconds (not more than 10 seconds) blot the liquid from the cloth with a piece of test paper. Use firm pressure while blotting and make certain that the liquid from the cloth is taken up by the paper.

(4) Remove the paper from the cloth and compare the extent of the color patch developed on the paper with that shown in figure 47.

(*a*) Positive results, indicating that the cloth has good protective value, are characterized by a blue-black color developed throughout all or the greater portion of the spot on the paper (fig. 47A and B).

(*b*) Negative results, indicating that the garment is low in protective value, may show a ring of color formed around the edge of the spot, with scattered color within the ring (fig. 47C and D) or, where the impregnite content is unusually low, may show no color at all. If there is doubt about a result, the test should be repeated.

(5) After the test has been completed, place a drop of the neutralizing solution (bottle C) on the tested spot of the garment and allow it to soak into the cloth. The spot is then marked with the black pencil to avoid retesting the same area.

47. PORTIONS TO BE TESTED. Sections of clothing subjected to friction and perspiration should be used as key points for testing, inasmuch as the impregnite content deteriorates more rapidly in such parts. In addition, whenever possible, the section tested should be of double thickness of cloth, such as pockets, collar lapels, cuffs of gloves, etc. This

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will eliminate the possibility of issuing garments which are not completely protective because of removal of protective agent from the spot tested.

48. SELECTION OF TEST GARMENTS. Clothing for test should be representative of a lot which has been stored or worn under approximately the same conditions. The results can then be taken as indicating the condition of the entire lot.

49. QUANTITY TO BE TESTED. Following is the quantity of garments to be tested under certain conditions:

a. From storage—at least one-half of 1 percent or 1 percent when taken from storage for wear.

b. After 2 weeks' wear, if not laundered and not to be laundered before additional wear, at least 5 percent.

c. After each laundering, at least 5 percent.

d. After exposure to blister gas vapor, at least 10 percent.

50. DISPOSITION OF CLOTHING. **a.** When 50 percent or more of the tested garments show negative results, reimpregnation of the entire lot is necessary.

b. When more than 50 percent of the test garments shows positive results and the remainder shows the presence of some impregnite, reimpregnation is not necessary.

c. When more than 50 percent of the test garments shows positive results and a high percentage of the remainder shows the presence of very little or no impregnite, the lot should be reimpregnated, or each garment tested and the lot sorted.

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CHAPTER 5

MISCELLANEOUS PROTECTIVE EQUIPMENT

SECTION I
INDIVIDUAL PROTECTIVE COVERS

51. GENERAL. **a.** The *cover, protective, individual,* is designed to protect against spray from aircraft. It is provided by the Quartermaster Corps and is issued in a small packet approximately 4 by 7½ by ½ inches, which is substantially airtight and moistureproof (fig. 48). The wrapper has a tear-tape device to provide positive and quick opening. The cover is so folded that, with a single movement of the hands, it may be opened quickly and be thrown over the head. The cover will provide protection against liquid blister gas for a period of hours but will not protect against blister gas vapors.

b. The *cover, protective, individual, cold climate* is similar to the cover, protective, individual except that it has a lining of scrim which enables the cover to withstand harsher treatment and to resist cracking at very low temperatures.

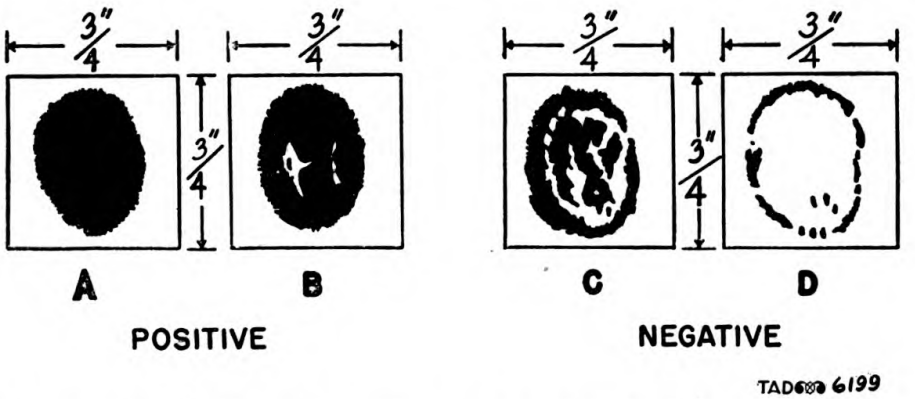

Figure 47. Positive and negative results obtained with impregnite test

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Figure 48. Individual protective cover (cover)

52. CARE AND USE OF COVERS. a. The individual protective cover and the cold climate individual protective cover are issued two per person in theaters of operations, and will be carried in the gas mask carrier. The cover intended for immediate use should be carried in the front part of the carrier, while the spare cover should be fitted next to the canister in the rear of the carrier (fig. 49). The cold climate cover is used specifically in cold climates and for training purposes because of its more rugged construction.

b. In the theater of operations, when the use of blister gas is a possibility, the rip tape of the cover intended for immediate use should be pulled and the end of the wrapper removed to permit the cover to be instantly withdrawn. At the same time the cover may be opened and refolded (to reduce sticking) and replaced in the wrapper. However, the latest issue of protective covers is wrapped in a cloth-covered aluminum foil. If not opened prior to use they will afford protection under all climatic conditions above 0° F. (instead of 32° F. for cellophane-wrapped covers). Therefore, caution should be exercised in deciding whether to remove the aluminum foil wrapper. If the wrapper is removed, the item will be susceptible to drying out, and may become unserviceable in temperatures below freezing. To open the cover, the wrapper having been removed, grasp the red tabs, one in each hand. While retaining hold on

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tabs, open cover by means of a quick movement of the hands, causing cover to unfold toward the ground. Swing the cover backward and to the right to obtain momentum, at the same time spreading the hands 12 to 14 inches apart (thus opening cover); then swing cover forward, filling it with air (as one would open a paper sack). Raise the cover with the hands, allow it to fall over the head, and pull down around the body. With proper training and practice, an individual armed with rifle or carbine can don the cover in 10 to 12 seconds.

c. The cover is intended to afford protection from liquid blister gas sprayed from the air. It should prevent contamination of clothing and reduce the requirements for decontamination. If the cover has been contaminated or torn to the extent of being unserviceable, it must be disposed of; otherwise it should be refolded and replaced in the carrier.

d. The cover is large enough to permit the performance of most combat duties. In driving a vehicle, the cover may be placed over the steering wheel, but should not be tucked in around the seat or body as this will cut off the air supply and quickly foul the air inclosed.

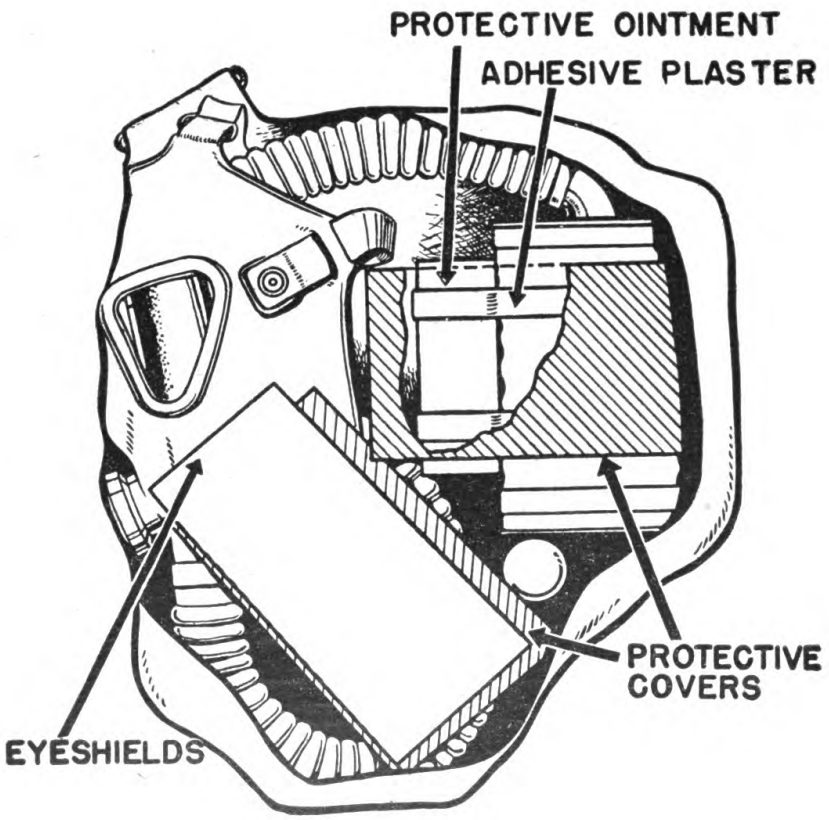

Figure 49. Protective covers carried in gas mask carrier

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53. INSPECTION AND MAINTENANCE. **a.** The wrapper will be examined for general condition. It should be substantially airtight and moisture-tight to preserve the cover in good condition. Open the wrapper by the special tape provided for that purpose and examine further. The wrapper should be tough and flexible, not brittle. Brittleness of the wrapper has little significance where covers are tightly packed in storage, but with covers in use, a brittle wrapper is likely to break, resulting in early deterioration of the cover. Such covers should be used as soon as practicable.

b. Throw the cover over the body. Note whether it opens readily, whether the taped seams and edges are intact, and whether the material cracks at the folds. Sticking of the material, separation of the tape at the seams or edges, or cracking at folds is sufficient cause for discarding the cover (par. 30). Note flexibility and toughness of cover material and transparency of the top section.

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SECTION II
GAS-RESISTANT APRON

54. GENERAL. The *apron, gas-resistant* (protective, impermeable), provided by the Medical Department is intended for use by certain personnel of the Chemical Warfare Service and of the Medical Corps who, in the performance of their duties, will come into contact with blister gases.

55. USE. **a.** The apron is always worn in conjunction with complete permeable protective clothing and impermeable protective gloves (rubber). The gas mask is also necessary as part of the complete protective outfit.

b. Before donning the apron, the adjustment of leg, waist, neck, and sleeve closures of the permeable protective clothing are inspected to determine whether a protective gas seal is obtained (pars. 4 and 11), and

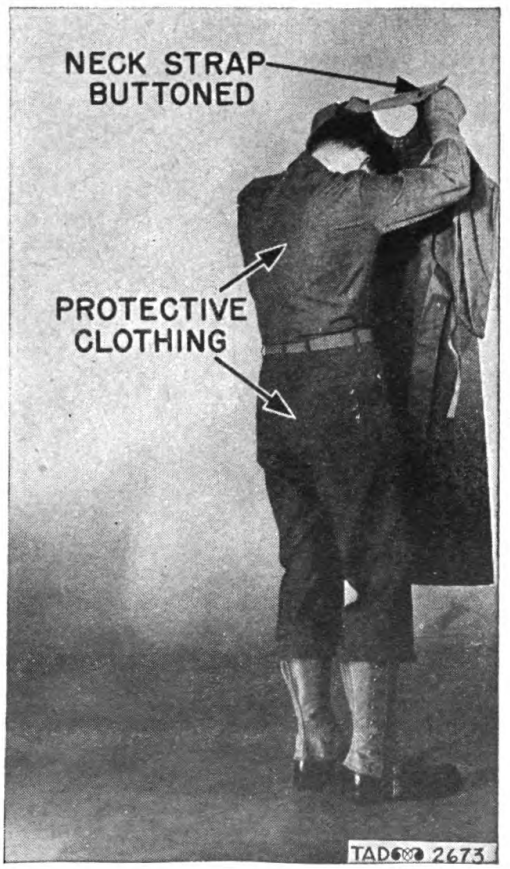

Figure 50. Thrusting head through opening in apron

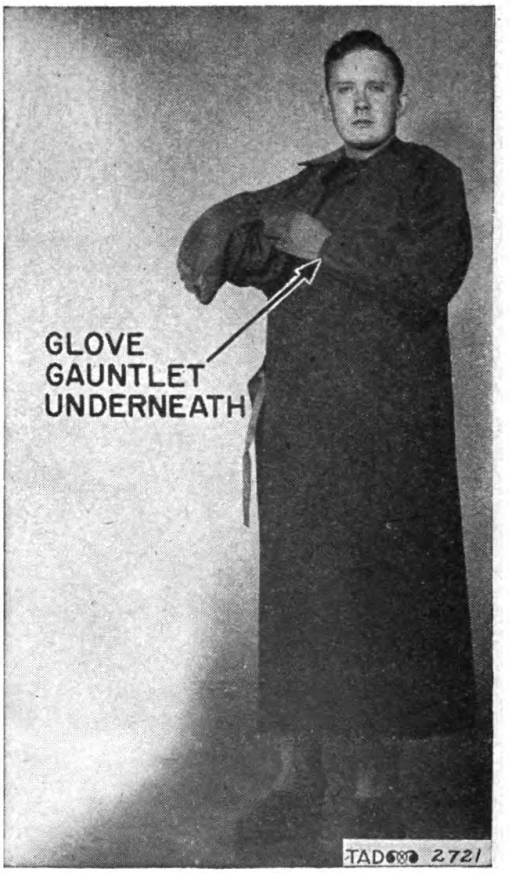

Figure 51. Thrusting arms through sleeves (apron)

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the protective gloves (cotton) are pulled on with the gauntlet drawn well over the sleeve of the shirt. With the neck strap of the apron buttoned, the head is thrust through the opening made by the neck strap and the apron (fig. 50); the left arm is inserted in the sleeve, and then the right arm, as shown in figure 51, and the tie straps and neck straps are adjusted to obtain a comfortable fit (fig. 52). The gas mask carrier is worn over the apron. Immediately prior to moving into a contaminated area or handling blister gases, the gas mask is adjusted. The collar of the shirt is turned up, and the hood, having been previously buttoned to the back of the shirt, is adjusted over the mask (par. 11). Impermeable gloves are put on prior to handling contaminated patients or material (fig. 53). If treatment of patients is hampered by the use of the impermeable gloves, the gloves may be taken off with comparative safety after removal of the patient's heavily contaminated clothing, and the treatment continued with protective gloves (cotton). Contaminated aprons may be worn with safety for many hours in conjunction with permeable protective clothing. Aprons should be decontaminated after each day of wear.

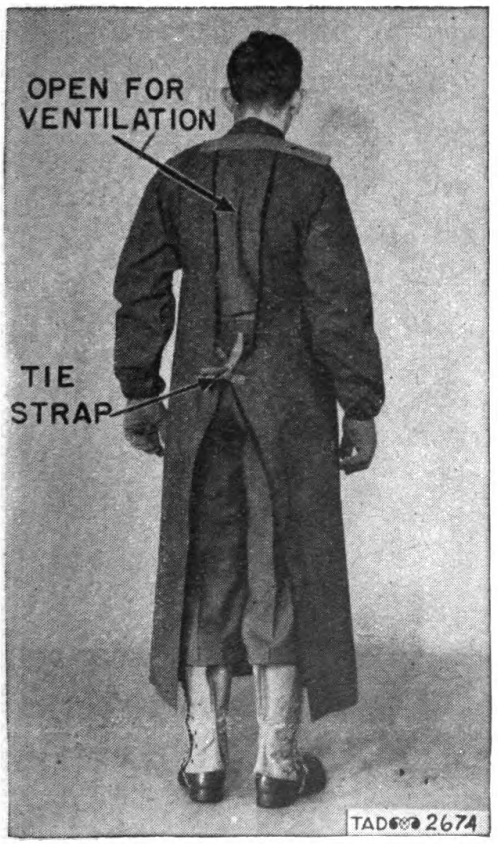

Figure 52. Straps tied (apron)

Figure 53. Protective apron correctly adjusted

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c. In removing the apron, follow procedure shown in detail in figure 54. Remove impermeable gloves; release the two gas-mask carrier straps allowing carrier to hang free; undo tie straps; unbutton neck strap with left hand; withdraw right arm from sleeve by inserting gloved forefinger of left hand under elastic cuff of other sleeve and pulling. (This procedure is repeated using right hand in withdrawing arm from left sleeve.) (See fig. 55.) The apron now falls freely from the body. Care must be exercised in the removal of the apron. Contaminated surfaces of the apron must not be permitted to come into contact with the clothing of the wearer or other individuals. Decontamination procedures will be applied as soon as possible to contaminated articles of clothing and equipment.

56. STORAGE AND SHIPMENT. Storage and shipment of the gas-resistant apron is the same as for impermeable protective clothing (par. 29).

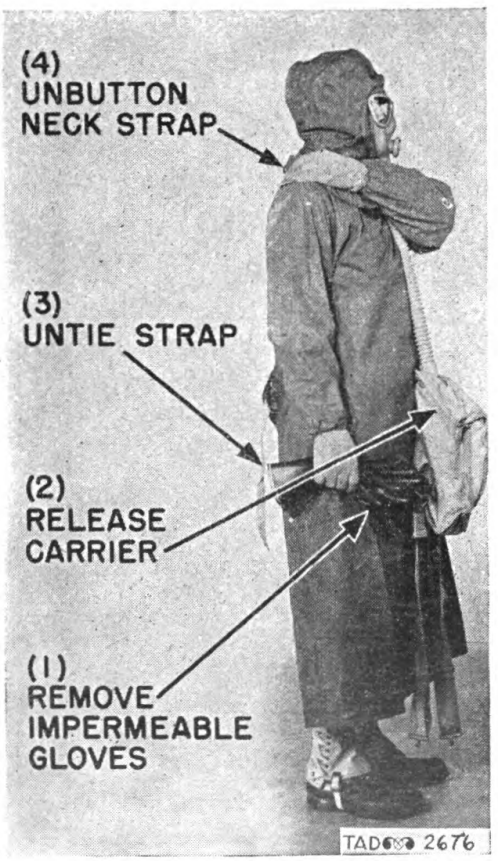

Figure 54. Steps 1 to 4 in removing apron

Figure 55. Removing arms from sleeves of apron

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SECTION III
GAS-RESISTANT SACK

57. PURPOSE. The *sack, gas-resistant, M1,* is designed specifically for the safe shipment of blister gas contaminated clothing to clothing decontamination stations.

58. DESCRIPTION. The sack, of laminated construction and made of kraft paper, asphalt cement, and scrim, is 56 inches long and 25 inches wide.

59. USE. One sack will hold two complete sets of clothing. When two complete outfits are deposited therein, the sack is sealed by folding over the top of the sack and tying the tapes tightly around the body of the sack. It is then ready for shipment. (Contaminated clothing (permeable, protective) will deteriorate if left in sacks for more than 48 hours. If shoes are packed in the sack, they must be wrapped in clothing. They must not come in contact with the inside of the sack.)

60. DISPOSITION OF USED SACKS. After sacks have served their purpose they will be immediately destroyed by burning. The unit receiving the contaminated clothing for decontamination will be reponsible for destruction of the sacks.

61. SAFETY PRECAUTIONS. **a.** Personnel handling contaminated clothing will wear gas masks, permeable protective clothing, and both cotton and rubber gloves.

b. A suggested aid in the filling of sacks is to tack them to two wooden frames, the width of a sack apart. This device will provide more efficient handling and will minimize the danger of contaminating the outside of the sack. The individual handling contaminated clothing should not roll and tie the sack. Two persons, working together, can do the job more quickly and safely than can one.

c. A pan of DANC solution and one of soapy rinse water should be available for the frequent immersion of the rubber-gloved hands, thus eliminating possible contamination.

d. Despite all precautions the outside of a sack may become contaminated. If this occurs, the same precautions must be observed in handling the sack as in handling contaminated clothing. Filled sacks should be transported in vehicles which can be easily decontaminated.

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e. The usual precautions will be observed against fire, blister gas contamination, and enemy observation when burning the sacks. Personnel will keep upwind of the fire.

62. MARKING. On one side of each sack the following directions are printed:

a. "USE FOR VESICANT CONTAMINATED CLOTHING *ONLY.*"

b. "ALWAYS WEAR GAS MASK AND PROTECTIVE CLOTHING WHEN PACKING AND UNPACKING SACKS."

c. "CAPACITY—2 SUITS OF CLOTHING."

d. "FOLD TOP OF SACK OVER, TIE TAPE TIGHTLY AROUND BODY OF SACK."

e. "DANGER: SACK MAY BE PENETRATED BY VESICANTS AFTER 48 HOURS CONTACT."

63. PACKING DATA. Twenty-five empty sacks are packed in a plywood box. The weight of the box is from 85 to 90 pounds, and its displacement is approximately 3 cubic feet.

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SECTION IV
EYESHIELD

64. GENERAL. The *eyeshield M1* is designed for protection of troops, in theaters of operations, against chemical spray attack by enemy aircraft. Its use may be extended to protection of the eyes against dust, wind, or blown sand.

Figure 56. Eyeshield adjusted

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65. DESCRIPTION. The eyeshield is a one-piece, flexible, transparent, plastic goggle cut to fit closely over the bridge of the nose and around the eyes. It is held in place over the eyes by a headstrap which the wearer may adjust so that the fit is comfortable (figs. 56 and 57). One-half of the headstrap is of elastic tape while the other half is of cotton webbing. Two eyeshields tinted green and two clear eyeshields are contained in a waterproof, open-end packet. Eyeshields are expendable and will be discarded when contaminated.

66. USE. Under conditions of gas warfare, the eyeshield is worn whenever enemy airplanes are known to be in the vicinity or at any other time when protection for the eyes is needed. When personnel are contaminated by liquid blister gas they must decontaminate with protective ointment before removing eyeshields and adjusting the gas mask. The eyeshield is not designed to fit beneath the gas mask and must be removed prior to adjusting the mask.

Figure 57. Eyeshield adjusted, with helmet

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SECTION V
PROTECTIVE OINTMENTS

67. GENERAL. *Ointment, protective, M1, M2, M3,* and *M4* is prepared for individual use to decontaminate any areas of the body, except the eyes, contaminated by blister gases. Instructions printed in training literature and on tubes of ointment which state that this ointment may be used as a "preventive" or "protection" against blister gases, or which state that the ointment is to be "mixed well with vesicant on skin" are rescinded. Protective ointment will be used as a first aid measure only *after* contamination by blister gas liquids and *before* skin redness develops.

68. DESCRIPTION. a. Regular pack. Protective ointments M1, M2, M3, and M4 are issued in collapsible tubes which, in turn, are individually packed in rectangular cardboard containers. A quantity of absorbent tissue accompanies the ointment.

b. Jungle pack. The "jungle pack" has been developed to protect the tube of ointment from becoming wet in damp, humid climates or due to immersion. The ointment is packaged in a cylindrical cardboard container approximately 2¼ inches in diameter and about 5 inches long. The container has a slip cover (friction fit) and has a strip of adhesive over the joint to keep out moisture. Each individual pack contains one tube of ointment and three swabs.

69. USE. The four ointments are similar. The greatest benefit will be obtained by applying them to contaminated skin within 2 minutes after contamination. Application of the ointment after skin redness develops will result in additional skin irritation. Three steps of decontamination are desirable:

a. Dry absorbent tissue is applied carefully in a blotting or dabbing manner to remove the liquid blister gas from the skin. Care must be exercised by the individual not to spread the liquid to uncontaminated areas.

b. A quantity of protective ointment, sufficient for the area contaminated, is squeezed onto the contaminated skin area (fig. 58) rubbed in

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with the fingers for approximately 15 seconds, and then wiped off. If the skin has been heavily splashed, the application and removal of the ointment should be repeated once.

c. When practicable the area is finally washed with soap and water.

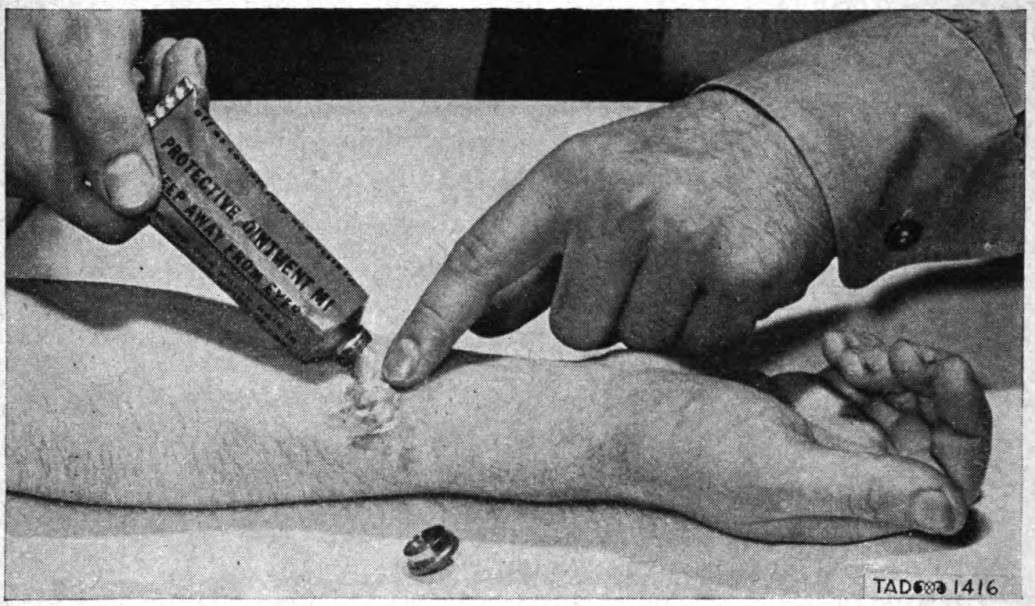

Figure 58. Applying protective ointment to arm.

SECTION VI
EYE OINTMENT, BAL

70. PURPOSE. *Eye ointment, BAL,* is designed to counteract the effects of liquid lewisite, lewisite vapor, and other arsenical blister gases in the eyes.

71. USE. For liquid lewisite or other arsenical blister gases in the eyes or for an exposure to their vapors severe enough to cause pain and spasm of the lids, eye ointment, BAL, should be applied to the eyes at once. If the eyes can be opened, the ointment should be squeezed dirctly into the eyes and the lids gently massaged. If not, the ointment should be applied to the closed eyes and rubbed into the slit between the lids; as soon as the pain lessens and the lids can be pulled apart, additional ointment

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should be squeezed into the eyes. A small quantity of BAL ointment should be rubbed on the eyelashes, lids, and skin around the eyes. *Caution:* BAL ointment must not be put into the eyes unless they are painfully affected by lewisite or other arsenical blister gas since the ointment causes pain and irritation to eyes not affected by these gases. It gives great relief from pain, however, to eyes affected by arsenical blister gases. As soon as the pain has begun to subside and the eyes can be opened, they should be thoroughly flushed with water. This is best done by tilting the head backward, holding the injured eye open by pulling on the lower lid with one hand, and slowly pouring water into the eye from a container held close to the eye with the other hand. The eyeball should be rolled from side to side and up and down during the washing, which should be continued for several minutes if sufficient water is available.

72. ISSUE. Eye ointment, BAL, is provided by the Medical Department. Three grams of the ointment are contained in a collapsible metal tube painted yellow with black lettering. The tube is approximately 2¼ inches long and ¾ inch wide and has a ¼-inch break-off tip (fig. 59). One tube is issued to each soldier entering the theater of operations.

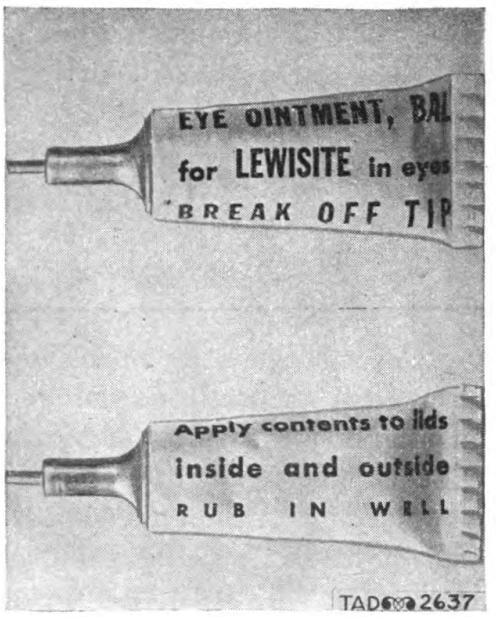

Figure 59. BAL ointment tube—front and rear view

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SECTION VII
SHOE IMPREGNITE M1

73. GENERAL. Shoes are made resistant to blister gases by applying *impregnite, shoe, M1,* furnished the individual soldier. Shoes are not treated originally with the impregnite. Each soldier will apply impregnite to his own shoes when directed to do so by proper authority. Shoe impregnite is issued by the Chemical Warfare Service in 8-ounce cans or tubes (fig. 60).

Figure 60. Can of shoe impregnite M1

74. DIRECTIONS. The impregnite is applied to regular issue shoes. Shoes should be cleaned, laces removed, and the impregnite rubbed thoroughly both on the inner and outer surfaces (fig. 61). The upper leather is kneaded and flexed continuously for about 15 minutes. Effort must be concentrated mainly on those parts of the shoe of only one thickness of leather. There should be an excess of impregnite on the shoes throughout the process. The shoes should be allowed to stand for a few hours before being worn. Any excess impregnite is then wiped off. Laces also should be treated. Shoes which have never before been treated are given two applications about 12 hours apart before they are worn for the first time. Thereafter they should be treated at least once a week. *Caution:* Shoe impregnite does not neutralize blister gas. It only prevents the liquid

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from penetrating the leather. Consequently, when shoes are contaminated with liquid blister gas the liquid should be wiped off as soon as practicable using handfuls of grass or leaves for this purpose. If possible, contaminated shoes should be shuffled in a mixture of earth or sand and bleach.

Figure 61. Applying impregnite paste to shoes

SECTION VIII
GAS CASUALTY FIRST AID KIT

75. GENERAL. a. The *kit, first aid, gas casualty,* is a medical item of issue, and is issued on the basis of one per 25 individuals in the theater of operations.

b. List of contents of kit.

Item 1—Chloroform, USP.
Item 2—Calamine lotion, NF (with 1 percent phenol and 1 percent menthol).
Item 3—Copper sulfate solution, 10 percent.
Item 4—Eye and nose drops.
Item 5—Eye solution M–1 (BAL).
Item 6—Cotton pads.
Item 7—Amyl nitrite.
Item 8—BAL ointment.
Item 9—Protective ointment.

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An instruction sheet covering the use of these items also is included in the kit.

c. Where these kits are available, full use will be made of the contents in first aid for gas casualties.

76. PROCEDURE FOR USE OF KIT. a. Blister gases. (1) GENERAL. Use *after* reddening of the skin has appeared. For relief of itching or pain of blister gas burn use item 2, calamine lotion, NF. Dab on affected area as required.

(2) MUSTARD GAS OR NITROGEN MUSTARD GAS. Liquid on skin. Use *item 9,* protective ointment, as outlined in paragraph 69.

(3) LEWISITE OR OTHER ARSENICAL BLISTER GASES.

(*a*) Use *item 5,* M–1 eye solution (BAL) for lewisite or other arsenical blister gas, in eyes. Open eye, using gentle force if necessary. Drop two to five drops of the solution into eye and let it stay. Apply a little solution to eyelids. Apply only *ONCE;* do *NOT* repeat.

(*b*) Use *item 8,* BAL ointment, for liquid lewisite or other arsenical blister gas on skin. Use in place of protective ointment. Blot skin dry. Apply ointment and rub in well with fingers.

b. Blood and nerve gases. *For hydrocyanic acid or cyanogen chloride,* use *item 7,* amyl nitrite. The gas mask should be fitted on the affected soldier. A pearl of amyl nitrite should then be crushed in its cloth container and inserted, as quickly as possible, through the side of the gas mask facepiece. The affected soldier should inhale the amyl nitrite for about 4 to 5 minutes when another crushed pearl should be inserted through the side of the facepiece. The insertion of a pearl may be repeated once, twice, or three times as indicated. While the inhalation of amyl nitrite is taking place, artificial respiration also is performed.

c. Vomiting gases. For relief of symptoms due to vomiting gases, inhale vapors of *item 1,* chloroform, USP, by sniffing vapors from mouth of bottle. Repeat as often as necessary to afford relief.

d. Screening smokes. In case of white phosphorus burns, use *item 3,* copper sulfate, 10 percent. Cover burning particles with cotton pads wet with copper sulfate. Then remove coated phosphorus particles with forceps.

e. General. (1) Use *item 4,* eye and nose drops, for relief of pain and congestion in eyes and nose, and *item 6,* cotton pads, as required.

(2) *Item 2,* calamine lotion also may be used for relief from itching caused by acid and incendiary burns except that it must *NOT* be used when burns are caused by white phosphorus.

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CHAPTER 6

GAS DETECTION DEVICES

SECTION I
H VAPOR DETECTOR KIT

77. GENERAL. a. The *kit, HS vapor detector, M4* (fig. 62) is designed to give a method whereby the presence of mustard gas vapor may be readily detected in the field. This kit is being withdrawn from issue and being replaced by the newer chemical agent detector kit M9 (sec. II).

b. The H vapor detector kit will detect mustard gas vapor at concentrations not perceptible by odor if the kit has been properly manufactured and is used correctly. Plant-grade mustard gas, the kind in use, contains a large amount of a relatively nontoxic impurity which is much more odorous than the mustard gas itself. The nose confuses the odor of this impurity with that of mustard gas. This odor is detectable far from an area contaminated with mustard gas and is not a reliable indication of the extent mustard gas vapors have traveled from the contaminated area.

c. Because of the highly odorous and highly persistent impurity, the nose cannot be trusted to determine the extent of contamination or the persistency of mustard gas.

d. Kits should be tested in accordance with paragraph 80. If kits are found to be satisfactory, gas personnel should be taught to regard the so-called mustard gas odor as an indication only of possible mustard-gas contamination and to regard the results obtained using the kit as conclusive evidence.

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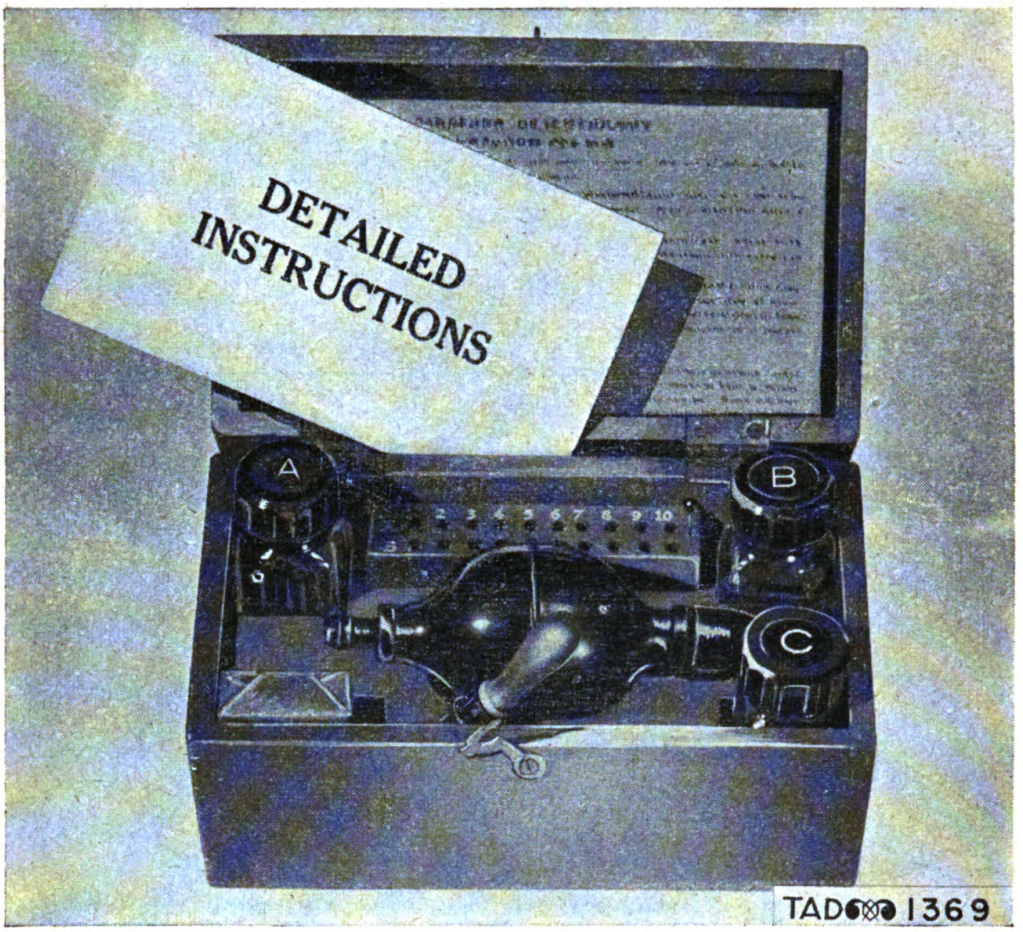

Figure 62. Contents of H vapor detector kit M4

78. DESCRIPTION. a. The kit consists of the following items mounted in a wooden case with hinged cover:

One bottle A containing a supply of prepared detector tubes.
One bottle B containing a 10 percent solution of sodium hydroxide (caustic soda).
One bottle C containing a dilute concentration of a toxic compound which reacts chemically like mustard gas.
One rubber aspirator bulb.
One medicine dropper.
One box of matches.
One sampling block with numbered holes for holding tubes before and after sampling.
One set of instructions mounted in lid.
One set of detailed instructions in envelope.

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TABLE I

COLOR DENSITY AND DEPTH

Bulb squeezes	Liters sampled	Color chart number					
		1	2	3	4	5	6
		Concentration in milligrams per liter					
1	1/20	0.010	0.020	0.100	0.200	1.000	2.000
2	1/10	0.005	0.010	0.050	0.100	0.500	1.000
5	1/4	0.002	0.004	0.020	0.040	0.200	0.400
10	1/2	0.001	0.002	0.010	0.020	0.100	0.200
20	1	0.0005	0.001	0.005	0.010	0.050	0.100

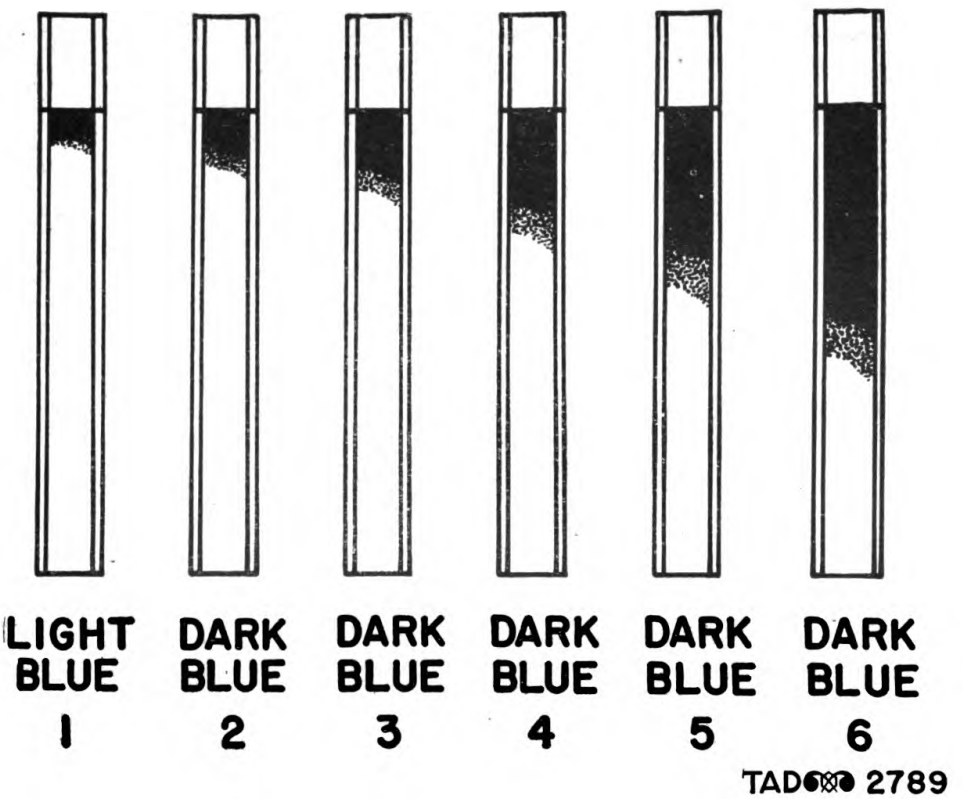

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TABLE II

EFFECTS OF H VAPOR

Concentration (milligrams per liter)	Exposure time									
	Minutes					Hours				
	5	10	20	40	60	2	4	8	16	24
0.0005	A	A	A	A	A	B	D	D	E	F
0.001	A	A	A	A	B	D	D	E	F	F
0.002	A	A	A	C	D	D	E	F	F	F
0.004	A	A	C	D	D	E	F	F	F	F
0.005	A	B	D	D	E	F	F	F	F	F
0.010	B	C	D	E	F	F	F	F	F	F
0.020	C	D	E	F	F	F	F	F	F	F
0.040	D	E	F	F	F	F	F	F	F	F
0.050	D	E	F	F	F	F	F	F	F	F
0.100	E	F	F	F	F	F	F	F	F	F
0.200	F	F	F	F	F	F	F	F	F	F
0.400	F	F	F	F	F	F	F	F	F	F
0.500	F	F	F	F	F	F	F	F	F	F
1.000	F	F	F	F	F	F	F	F	F	F
2.000	F	F	F	F	F	F	F	F	F	F

A—No effects on eyes or skin.

B—No mask worn: Either no effect on eyes or mild reddening of eyes.
Without protective clothing:
Normal skin: No effect.
Hot and sweaty skin: Very mild reddening.

C—No mask worn: Mild eye irritation.
Without protective clothing:
Normal skin: No effect.
Hot and sweaty skin: Reddening; possible casualty.

D—No mask worn: Temporary blindness; 4 to 14 days disability.
Without protective clothing:
Normal skin: Mild reddening.
Hot and sweaty skin: Reddening to possible casualty.

E—No mask worn: Temporary blindness; certain eye casualty for more than 1 week and permanent eye injury; severe effect on lungs and throat.
Without protective clothing:
Normal skin: Reddening; possible casualty.
Hot and sweaty skin: Blisters, probable casualty.

F—No mask worn: Permanent eye injury; pneumonia; possible death.
Without protective clothing:
Normal skin: Very red; blisters; some casualties.
Hot and sweaty skin: Very red; blisters; severe casualties.

NOTES: 1. Casualties from mustard gas are much more severe under conditions which cause the skin to be hot and sweaty.
2. The above effects are based on continued wearing of vapor-contaminated clothing for several hours after exposure.

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b. The detector tubes in bottle A are ready for use. Each is packed with a layer of almost colorless grains held in place between cotton wads. The red dot on the tube is a heat-indicating paint.

c. The rubber sampling bulb, when fully compressed and released, will draw in a sample of approximately 50 milliliters of air. Prior to use it should be checked for possible leakage (par. 80). When much leakage is shown, the outlet valve at the end of the bulb opposite the tube holder should be examined. If the bulb cannot be repaired, it should be replaced.

79. PRINCIPLE OF OPERATION. a. Briefly stated, the principle on which this detector is based is as follows: Air to be tested is drawn by means of a rubber suction bulb through a tube containing a special reagent which adsorbs and holds any mustard gas vapor present in the atmosphere sampled. A simple treatment causes the adsorbed mustard gas to react to give a blue color, the intensity of which is proportional to the amount of mustard gas which was drawn through the tube.

b. The test is highly sensitive and concentrations as low as 0.0005 milligrams of mustard gas vapor per liter of air can be detected in this manner provided that a sufficiently large sample of the contaminated air is drawn through the tube. The selectivity of the test is also reasonably high. Only a few other war gases (par. 83) which could conceivably be present where mustard gas can be expected give a similar result or interfere with it. The test is therefore of great value under a wide variety of circumstances where a very sensitive method must be used both to detect and to identify mustard gas.

80. PROCEDURE FOR TESTING AND USING KIT. a. Testing is carried out in the following manner:

(1) RUBBER BULB. Squeeze the bulb tightly with one hand. Place a finger of the other hand over the hole in the rubber stopper. Release the pressure on the bulb, while holding finger firmly over the hole. The bulb should not become filled with air in less than 20 seconds.

(2) RUBBER STOPPER. Insert a detector tube from bottle A into the hole in the rubber stopper. The rubber stopper must be pliable. The tube should fit in easily and yet be held firmly.

(3) BOTTLE A. (*a*) The detector tubes should contain sensitive grains held between two cotton pads. The cotton pads should be small. The entire filling, sensitive grains and pads, should occupy no more than half the tube. There should be a red dot opposite one of the cotton pads. The pads should be white. The sensitive grains should be white or, at the most, tinted only a pale yellow.

(*b*) Insert a tube into the rubber stopper of a bulb which has passed the leakage test, squeeze the bulb completely, release the pressure, and the bulb should fill up completely in not more than 8 seconds. This tests the resistance of the tube to passage of air through it.

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(*c*) Heat the tube with a lighted match until the red dot turns yellow. Allow the tube to cool, and add solution B (enough to wet contents of tube) from the kit being tested. The sensitive grains, on being wetted with this solution, should remain colorless or, if a faint brown appears, it should fade in a few seconds.

(*d*) Take a second tube and sample the air in bottle C by two squeezes of the bulb. Heat the tube until the red dot turns yellow, allow the tube to cool, add solution B from the kit being tested, and a distinct blue color should appear on the upper part of the sensitive grains when they are wetted with the solution.

(*e*) If no blue color appears, take a third tube and sample the air in a mustard "sniff" bottle by one squeeze of the bulb. Heat the tube until the red dot turns yellow, allow the tube to cool, add solution B from the kit being tested, and a distinct blue color should appear on the upper part of the sensitive grains when they are wetted with the solution.

(4) FACTS DETERMINED. The facts determined by testing these three tubes are:

(*a*) *First tube (no agent sampled).* If any of the faults mentioned are present, or if the tube turns blue on addition of solution B, without having sampled anything, the tube is unsatisfactory and there is no need to perform the second or third tests.

(*b*) *Second tube (air in bottle C sampled).* If the tube does not give a blue color on correct treatment after sampling the air in bottle C, either the tube or bottle C is unsatisfactory.

(*c*) *Third tube (air in mustard sniff bottle).* If the tube gives a blue color on treatment after sampling the air in a mustard "sniff" bottle, bottle C is unsatisfactory.

(*d*) If the tube does not give a blue color on correct treatment after sampling the air in a mustard sniff set, either the tube or bottle B is unsatisfactory, and bottle C may be unsatisfactory.

(*e*) If parts of a kit which have passed the tests are available, they may be used to determine further what parts are at fault.

(5) ACTION TO BE TAKEN. Any item or combination of items which fail this test must be replaced. If one detector tube is unsatisfactory, bottle A and all its tubes must be replaced. The correct working of the kit depends upon every item being able to pass this test.

b. Use the kit as follows (par. 88a):

(1) Remove a tube from bottle A and place the longer open end in adapter of rubber sampling bulb (fig. 63).

(2) Sample contaminated air by squeezing and releasing bulb. (For number of squeezes see par. 82.)

(3) Remove tube from bulb and, *holding tube in fingers at its longer open end,* heat opposite half (marked by red dot) by passing back and

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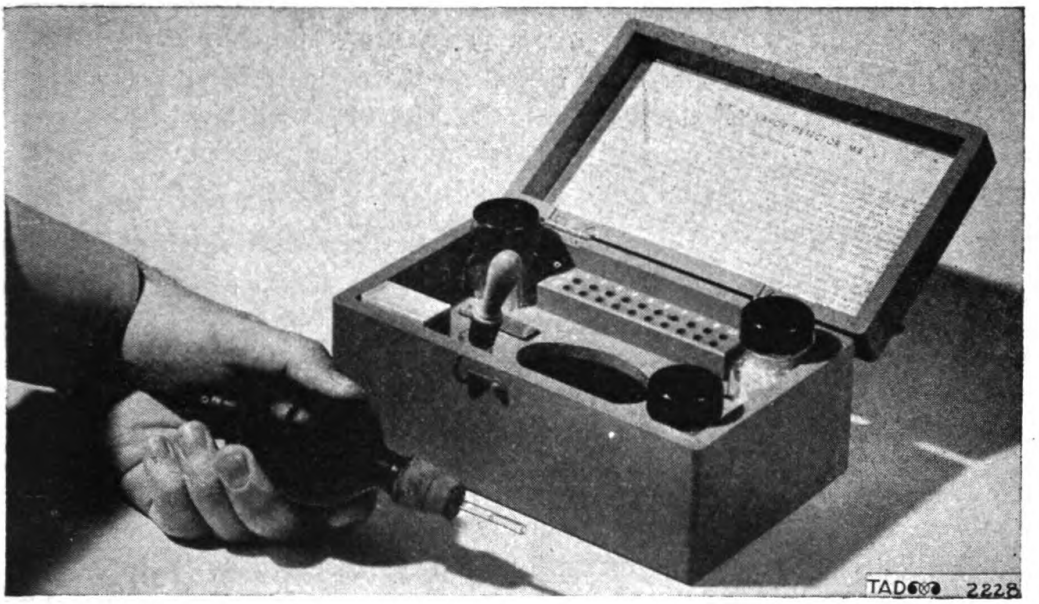

Figure 63. Detector tube in aspirator bulb

forth through flame of a lighted match or an alcohol or gas burner. When red dot *begins* to turn yellow, remove tube from flame and allow to cool for 1 minute. (Do not prolong heating until cotton plug is charred.)

(4) Wipe off any carbon deposited by flame. Hold tube upright (red dot up), and drop into it enough solution from bottle B to wet thoroughly the contents of the tube, using for this purpose the medicine dropper provided in the kit. When the solution wets the sensitive grains, a blue color will develop if sufficient mustard gas has been sampled.

(5) If it is not convenient to carry out the process of development immediately after the air has been sampled, the exposed tube may be removed from the bulb and placed in one of the numbered holes of the sampling block, with a record of the number kept for future identification. At any time up to at least several days the tube can be developed as outlined above, except that, if allowed to stand for more than 1 hour, the tubes do not have to be heated, but simply treated with the solution in bottle B. Heating does no harm. This procedure is often of advantage when a large number of samples are to be taken and there is no need for immediate development.

81. QUANTITATIVE MEASUREMENT. The intensity of color and the depth to which it extends through the sensitive layer is proportional to the amount of mustard gas vapor adsorbed. The amount adsorbed is in turn proportional to the concentration of the mustard gas vapor in the air and to the volume of gas sampled. By drawing known amounts of air through tubes and comparing the color obtained with standards, it is

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possible to estimate the approximate concentration of mustard gas vapor as lying within one of four or five magnitudes. The color tests made by sampling known concentrations of mustard gas vapor are not sufficiently stable to be kept, and the standards therefore have to be shown by permanent colors (table I).

82. APPLICATION. a. Detection of dangerous concentrations of mustard gas vapor. (1) The semiquantitative characteristics of this detector make it possible to determine whether the air contains a dangerous amount of mustard gas vapor. In interpreting results obtained by sampling vapors of mustard gas in air, it must always be remembered that this is no guide to the amount of liquid mustard gas present on a contaminated surface. Air over a contaminated area will not contain uniform amounts of mustard gas vapor since the concentration will be largely influenced by temperature, wind speed, and the distance from the contaminated surface. Samples should therefore be taken at several points in the area and at different distances from the ground. The effect of wind is important in testing for war gases. It influences both chemical tests and odor. At one moment, a sample of air of comparatively high vapor concentration may reach the observer; at the next moment, there may be nothing. This explains apparently contradictory results obtained in testing an area. Tests usually should be repeated, especially when negative results are obtained. The travel of an invisible toxic vapor in the air can be visualized by watching a smoke cloud. In a gusty wind, the concentration of smoke will vary greatly over a small area. This also is true with toxic vapor.

(2) The size of sample to be taken will be influenced largely by the lowest concentration it is deemed desirable to detect. Generally speaking, it is best to obtain a total adsorption of mustard gas vapor which will give a color reaction equal in color density and depth at least to the No. 2 tube in table I to obtain a strong, positive result. If this requires an excessive number of bulb squeezes, the number of squeezes can be reduced until the No. 1 tube has been matched in color density. Table I can be used as a guide to determine the volume of air or the number of bulb squeezes to be taken.

(3) Interpretation of the concentration of vapors from milligrams per liter into terms of "safe" or "dangerous" depends largely upon the time personnel will be exposed to the vapors. Table II provides an interpretation of table I in terms of the effect a given concentration of mustard gas vapor may be expected to have upon personnel exposed for a stated time. It will be noted that the factors of body temperature and the presence or absence of perspiration influence considerably the degree to which skin is affected. An example of how table II may be related to

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table I is as follows: Suppose five bulbfuls of air suspected of H contamination have been drawn through the tube, representing one-quarter of a liter, as per table I. By reference to table I it is found, for example, that the color developed in the tube after treatment corresponds to the depth and intensity of the blue depicted in the No. 3 tube. The No. 3 column under "Color chart number" in table I gives, for five bulb squeezes, a concentration value in milligrams per liter of 0.020. This figure is then related to table II, and the letter shown under the proper column of "Exposure time" related in turn to the explanatory legend of table II. If the length of exposure, for example, had been 20 minutes, the resulting letter would be "E," and the resulting effects as follows: "No mask worn: Temporary blindness; certain eye casualty for more than 1 week and permanent eye injury; severe effect on lungs and throat. Without protective clothing: *Normal skin:* Reddening; possible casualty. *Hot and sweaty skin:* Blisters; probable casualty."

b. Detection of surface contamination. (1) Mustard gas contaminated surfaces can be detected by holding the end of a detector tube within ¼ inch from the suspected surface while drawing the vapors through the tube. For this purpose, the number of squeezes of the bulb necessary will depend on the factor of temperature. The volatility of mustard gas varies greatly at different temperatures, and on a cold day a larger sample will be necessary than on a warm day. On a moderate day, one bulbful of air will be sufficient to give a strong positive result, if the contamination is of recent origin.

(2) The test should be regarded as only qualitative, since the depth of color obtained does not necessarily indicate the amount of liquid present. The sample should be drawn with the tip of the tube close to but not actually touching the surface which is being tested. Samples of soil and other loose material can also be tested by placing them in a tightly stoppered bottle and testing the air above the sample after it has been confined for a short time, warming the contents of the bottle if necessary to increase the concentration. In testing old contaminated surfaces it may be observed that a strong odor resembling mustard gas is present, but that a negative result will be obtained with the indicator. This apparent failure of the indicator to function is due to the fact that the nonvolatile residues of Levinstein process mustard gas, which have an odor more powerful than mustard gas itself, have remained on the surface after the mustard gas has evaporated. When such a case is found, it can be interpreted that the mustard gas used was probably Levinstein process mustard gas, and that the contamination occurred at a not very recent date. The same would also apply to surfaces which had been decontaminated by bleach or a similar chlorinating agent. In this case, a strong, mustard gas odor may be detected, *but due to the low volatility* c

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the residue a positive result may not be obtained with the indicator. Reliance on the kit and not the nose is a matter of gas discipline. Troops should recognize odors, but they should learn to regard odors as a warning of possible contamination rather than as an absolute certainty. At high temperatures, despite residual odors, it must be realized that evaporation is fairly rapid.

c. Leaking gas shell in magazines. The presence of leaking mustard gas shell or containers in magazines can be detected by sampling the air of the magazine. If the magazine is large, a number of tests in different parts of the inclosure should be made. The volume of sample necessary will depend upon the temperature, ventilation, and the proximity to the leakers. Generally, the sample should be as large as it is convenient to take.

d. Detection of contaminated food, water, clothing, and other materials. Tests can be made on food, water, clothing, and other articles in the field or on samples of these materials brought into the laboratory. If the test is conducted in the field, five to ten bulbfuls of air taken with the tube close to but not actually touching the material should be sufficient. Personnel who have traveled through an area suspected of contamination should test tires of their vehicles or, if on foot, should test their shoes. Samples brought into the laboratory in containers can be tested by drawing some of the air from the top of the container through the tube. Warming the closed container for a few minutes will greatly increase the concentration by causing more rapid vaporization of mustard gas from the sample.

e. Efficiency of decontamination methods. (1) This kit can be used not only to determine the necessity for decontamination, but also to determine when the decontamination is complete. When used for the second purpose, however, precautions must be taken in interpreting results. Most decontamination methods make use of some form of chlorinating agent with the resultant formation of chlorinated mustard gas products. The composition of these varies greatly according to the degree to which the chlorine has reacted. Most of these products have some effect on the indicator, but the colors developed are inclined to be red rather than the blue given by the mustard gas itself. Experience with the blue color will enable the operator to distinguish this reddish color when it appears. It is best to wait for some time after the decontamination before making tests, as this allows the high concentrations of volatile solvent vapors from the decontaminating solution, which might interfere to some extent, to blow away.

(2) If vehicles and equipment are decontaminated by steam or water, no products are formed which will interfere with the effectiveness of the test. These methods wash away a large amount of undestroyed mustard

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gas and usually the test will give strong indications of mustard gas near the ground and over puddles of water under equipment.

83. LIMITATIONS. There are certain limitations as to the use of this kit which, if thoroughly understood, can be overcome in most cases.

a. A number of other war gases give either a similar test or react in some other way to cause a color change distinct from that given by mustard gas. Most of these gases are tear gases, and concentrations high enough to interfere with the mustard gas test are usually self-evident from their effect on the eyes. Those gases giving a positive result when the test is made for mustard gas, and the character of the color change are as follows:

(1) ETHYL BROMACETATE. Blue.
(2) DIMETHYL SULFATE. Blue.
(3) CHLORACETOPHENONE. Reddish blue.
(4) BENZYL CHLORIDE. Reddish violet.
(5) XYLENE BROMIDE. Blue.
(6) CHLORPICRIN. Brown.
(7) SULFUR CHLORIDE. Brown.
(8) NITROGEN MUSTARD GASES. Blue.

To differentiate between mustard gas and nitrogen mustard gases it is necessary to test with either the M7 or M8 crayon or the M9 kit (sec. II).

b. Some gases giving a color test as soon as adsorbed or when the tube is warmed after a sample is taken are:

(1) CYANOGEN CHLORIDE. Yellow direct; orange on heating.
(2) CYANOGEN BROMIDE. Yellow direct; orange on heating.
(3) XYLENE BROMIDE. Orange-yellow direct.
(4) BROMBENZYLCYANIDE. Yellow to orange on heating.

c. There are a number of substances which may interfere with the test. Among these are hydrochloric acid or compounds which hydrolyze readily to form hydrochloric acid, such as lewisite and phosgene. If these substances are present in high concentrations, they interfere by rendering the solution in bottle B nonreactive. This has been partly overcome by making the solution in bottle B sufficiently strong so that ordinary amounts of hydrochloric acid do not interfere. It is only in very unusual circumstances that any interference will be encountered from this source.

d. Some of the chlorinated products of mustard gas give a reddish-blue test, but the sensitivity is not as high because of their much lower vapor pressure. Mustard polysulfide, the chief constituent of the nonvolatile residue of crude Levinstein mustard gas, reacts in a similar manner to mustard gas itself but, owing to the very low vapor pressure of this substance, a positive result cannot be obtained from its vapors unless a

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very large volume of air is sampled. Oxidized mustard gas (mustard sulfoxide) will not give a positive result; neither will the hydrolysis product of mustard gas (thiodiglycol).

84. CARE OF KIT. Although no special precautions must be observed in using or transporting the M4 kit, reasonable care must be exercised to insure that bottles and detector tubes are not broken or their contents spilled. The hinged cover must always be fastened when the set is transported. This will safeguard the bulb and dropper, as well as the rest of the contents.

SECTION II
CHEMICAL AGENT DETECTOR KIT

85. GENERAL. The *kit, chemical agent detector, M9* is a compact unit used for the determination of dangerous concentrations of chemical warfare gases. It reveals color changes in tubes through which the contaminated air is drawn by means of a pump and to which liquid reagents are added. The persistent gases detected are H (par. 77b and c), the nitrogen mustard gases, ED, and MD. The nonpersistent gases detected are CG and CC.

86. DESCRIPTION. **a**. The complete detector kit (figs. 64 and 65) consists of an olive-drab, cotton duck carrier, 8½ inches wide, 5½ inches high, and approximately 3 inches thick. It weighs about 2½ pounds. A carrier strap is provided in order that the kit may be carried easily.

Figure 64. Complete detector kit M9

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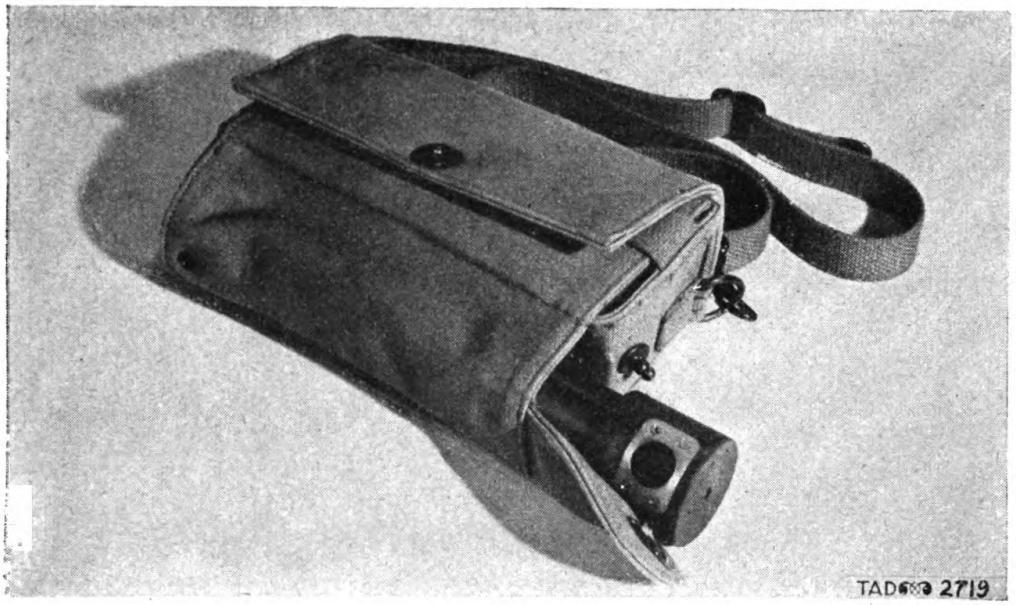

Figure 65. Complete detector kit M9, showing flashlight-pump

b. Components of the kit (fig. 66) are as follows:

1 kit carrier with carrying strap.
1 air-sampling pump, including flashlight.
42 mustard gas and nitrogen mustard gas detector tubes (blue spiral wrapper).
25 nitrogen mustard gas detector tubes (red spiral wrapper).
25 arsenical detector tubes (yellow spiral wrapper).
25 phosgene detector tubes (green spiral wrapper).
25 sampling tubes (plain wrapper).
2 aluminum bottles of liquid reagent.
1 blue bottle of liquid reagent.
1 red bottle of liquid reagent.
1 aluminum vial of solid reagent (in pump handle).
1 blue vial of solid reagent (in pump handle).
1 red vial of solid reagent (in pump handle).
1 waterproof cloth bag (in front pocket).
1 set of general directions for use of kit, chemical agent detector, M9 (in front pocket) attached to kit by waterproof twine.
1 package of cellophane envelopes with report cards (in rear pocket).
1 pencil (above rear pocket).

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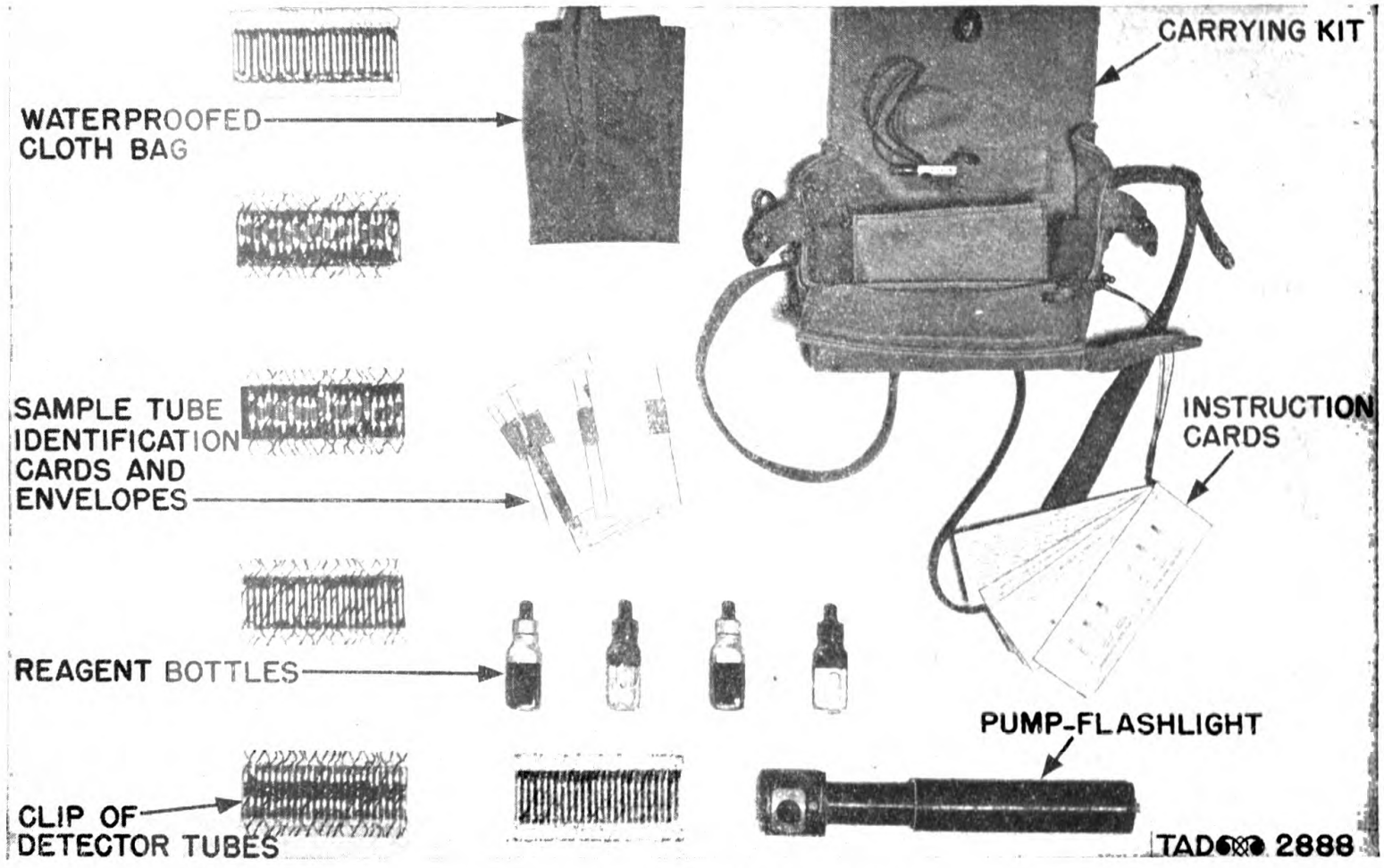

Figure 66. Contents of detector kit M9

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c. Pump-flashlight (fig. 67). (1) When extended, one stroke will draw through it a sample of approximately 100 milliliters of air. Prior to use, it should be checked for leakage by pushing in the plunger as far as possible, covering the inlet end with a finger, and pulling on the plunger to extend it.

(2) The pump is ruggedly constructed and only a little care is required to keep it in good working order.

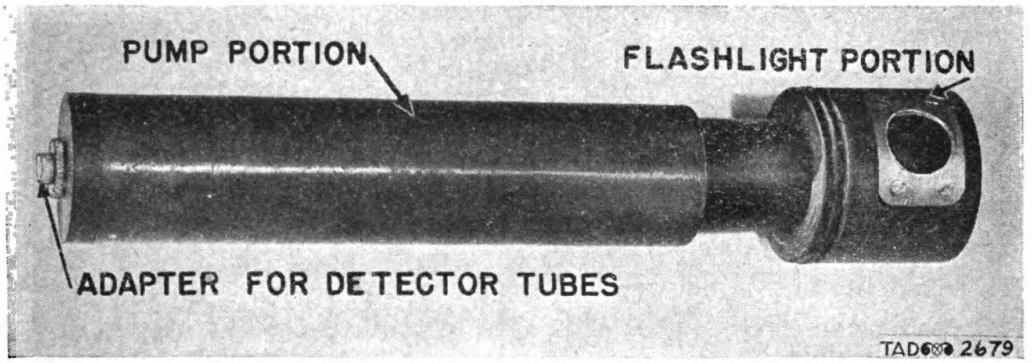

Figure 67. Pump-flashlight

(3) The flashlight portion of the pump can be easily removed by unscrewing the section containing the flashlight (fig. 68). The battery and bulb are easily replaced while the flashlight is in the dismantled condition.

(4) In the pump handle are three vials of solid reagent which are used as refills for the kit (fig. 68).

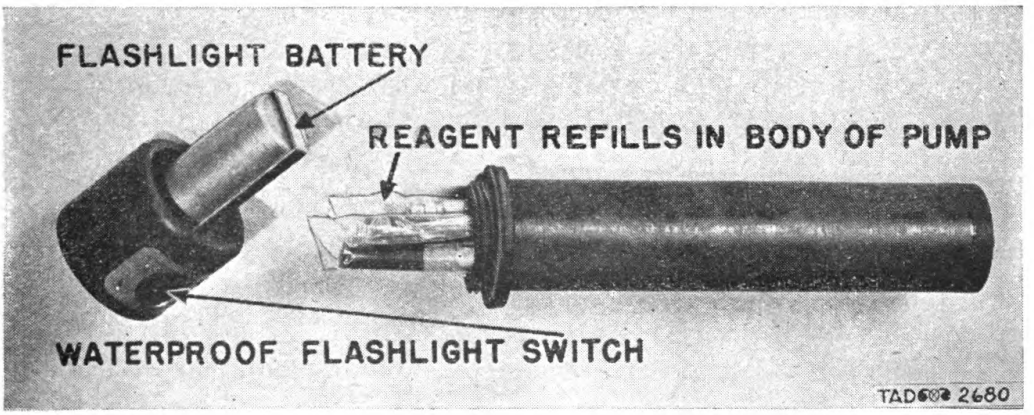

Figure 68. Flashlight portion of pump removed to show battery and reagent refills

87. PRINCIPLE OF OPERATION. a. The principle on which this detector kit operates is as follows: air to be tested is drawn, by means of the pump, through a tube containing a special reagent which adsorbs any of the gases specific for the tube. A simple treatment causes the adsorbed

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gas to react to form a definite color, the intensity of which is in proportion to the amount of gas which was drawn through the tube.

b. The test is a sensitive one and concentrations as low as 0.0005 milligrams of mustard gas vapor and approximately 0.0005 milligrams of nitrogen mustard gas vapor per liter of air can be detected in this manner provided that a sufficiently large sample of the contaminated air is drawn through the tube. The selectivity of the tests is reasonably high. The tubes are therefore of great value under many conditions where a very sensitive method must be used to detect and identify the war gases.

88. PROCEDURE FOR MAKING TESTS. a. General. Gas masks must be worn and other protective measures must be taken *before* the kit is used whenever crying, sneezing, or coughing occurs or whenever any suspicious odor or other sign of gas is noticed. The kit is then employed to establish the presence or absence of the above-mentioned gases and, after sufficient time is allowed for nonpersistent gases to disappear, the kit is used to determine when it is safe to remove the gas mask as evidenced by the absence of color changes in the tubes. The kit is of great value in testing for the presence of gas, particularly persistent gas, in areas recently abandoned by the enemy.

b. Directions. (1) First test for mustard gas and nitrogen mustard gas by pulling off a blue spiral tube from the clip.

(*a*) Tear off the cellophane wrapper, insert the end marked with a blue dot into the pump (fig. 69), and *slowly* take three pump strokes close to the ground or suspected contaminated surface.

(*b*) Remove the tube from the pump and add liquid from the aluminum bottle to the aluminum foil heating pad (fig. 70) on the tube by means of the eye dropper, wetting the paper edges and seam until the aluminum foil is completely discolored and steam appears.

(*c*) When the tube is cool (45 seconds), pull off the heating pad. Then introduce liquid from the blue bottle into the unmarked end of the tube by means of the eye dropper until the sand grains are wetted. A blue color indicates the presence of mustard gas or of nitrogen mustard gas. If a blue color appears proceed to step 2 (red spiral tube) and test for nitrogen mustard gases.

(*d*) If no blue color appears, omit step 2, and proceed to step 3 (yellow spiral tube) and test for arsenicals.

(2) To test for nitrogen mustard gases (only if a blue color appeared in the blue spiral tube) pull off a red spiral tube from the clip.

(*a*) Tear off the cellophane wrapper and insert the end marked with a red dot into the pump and *slowly* take three full pump strokes close to the ground or suspected contaminated surface. A pink color indicates the presence of nitrogen mustard gas.

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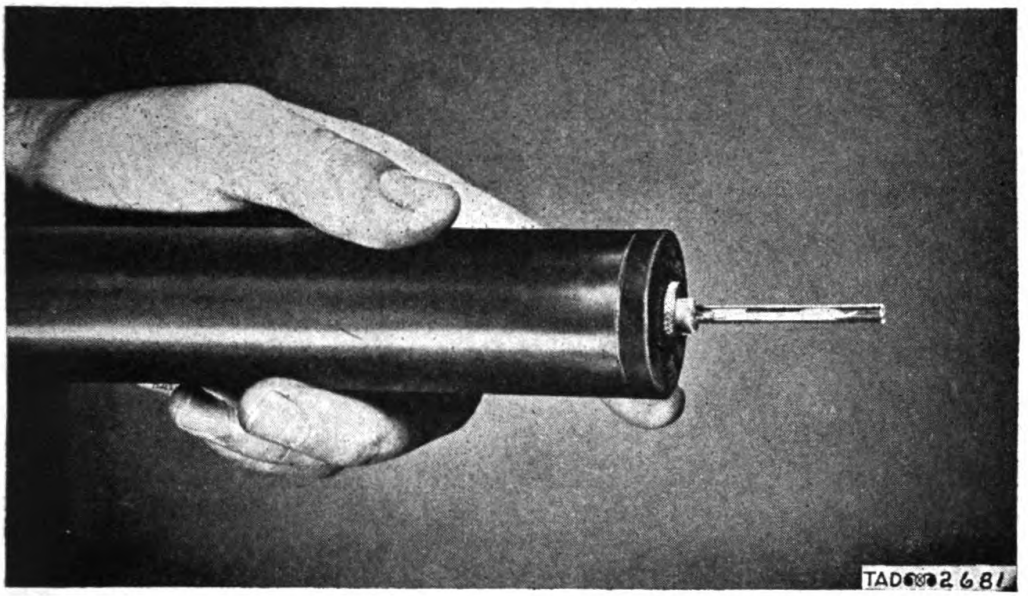

Figure 69. Detector tube inserted in pump

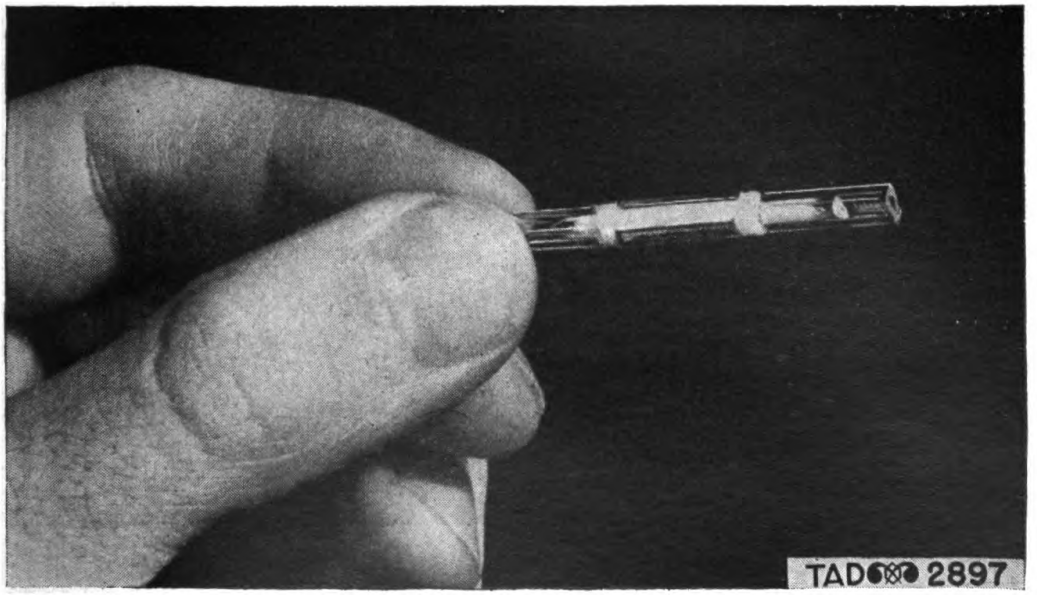

Figure 70. Aluminum foil heating pad on H detector tube

(*b*) To confirm, remove the tube from the pump and introduce liquid from the red bottle into the unmarked end of the tube by means of the eyedropper until the sand grains are wetted. An *immediate* orange-red color confirms the presence of nitrogen mustard gas. Ignore any color change which appears after the wet tube stands for 1 minute. A blue color in the blue spiral tube and no orange-red color in the red spiral tube indicate the presence of mustard gas.

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(*c*) Proceed to step 3 (yellow spiral tube) and test for arsenicals.

(3) To test for arsenicals, pull off a yellow spiral tube from the clip.

(*a*) Tear off the cellophane wrapper, insert the end marked with a yellow dot into the pump, and *slowly* take three full pump strokes close to the ground or suspected contaminated surface. A blue color indicates the presence of ED or MD.

(*b*) Now proceed to step 4 (green spiral tube) and test for CG.

(4) To test for CG, pull off a green spiral tube from the clip.

(*a*) Tear off the cellophane wrapper, insert the end marked with a green dot into the pump, and *slowly* take three full pump strokes close to the ground. A light green to dark green indicates the presence of CG.

(*b*) Now proceed to step 5 (blue spiral tube) and test for CC.

(5) To test for CC, pull off a blue spiral tube from the clip. Tear off the cellophane wrapper and remove the aluminum foil heating pad. Insert the end marked with a blue dot into the pump and *slowly* take three full pump strokes close to the ground. A yellow color indicates the presence of CC.

(6) To sample a gas the identity of which is uncertain, for sending to a rear area laboratory, insert the end of a sample tube (plain wrapper) marked with a white dot into the pump and *slowly* take 30 full pump strokes in the area of highest concentration, such as indoors or just above a puddle of the suspected liquid.

(*a*) Repeat, if possible, using several tubes.

(*b*) Write information on card in envelope (fig. 71).

(*c*) Inclose card and tubes in envelope, seal, and send to the division chemical officer, who will have contents of tubes analyzed.

c. Miscellaneous information on procedure. (1) To replenish liquid reagents in the aluminum, blue, or red bottles, empty the contents of the appropriate vial (stored in the handle of the pump) into the bottle, fill with water (not chlorinated), and shake until the reagent dissolves.

(2) If the eye dropper in the aluminum bottle breaks, pour the liquid onto the aluminum foil heating pad until steam appears. If the eye dropper in the blue bottle or the red bottle breaks, dip the proper end of the tube requiring the reagent into the liquid and hold until the sand grains are wetted.

(3) Before entering water, or in a heavy rain, place the entire kit in the waterproof bag (fig. 72), wrap tightly with the carrying strap, and attach one end of the strap to the belt.

89. USE. a. Detection of dangerous concentrations of war gases. (1) The sensitivity of the detector tubes makes it possible to determine whether the air contains a dangerous amount of gas. In interpreting results obtained by sampling air or vapors, one must be certain that the

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Adsorbed Gas Sample

TO: DIVISION CHEMICAL OFFICER

From:.....

Unit: .....

Place: .....

Date..... Time.....

Characteristics of Gas:

Appearance

Smell

Comments

(over)

Effect on Men

Effect on Detector Tubes

Mustards Tubes:

Nitrogen Mustards Tubes:

Arsenicals Tubes:

Phosgene Tubes:

TAD 2860

Figure 71. Unknown agent information card

Figure 72. Detector kit M9 in impermeable bag

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samples are taken at several points and in accordance with wind conditions (par. 82).

(2) The detector tubes are sufficiently sensitive that three full strokes of the pump will detect a concentration of the gas far below the concentration necessary to cause casualties in 50 percent of unprotected troops. (See chart below.)

War gas	Dangerous concentration (less than 50% casualties)	Approximate sensitivity of detector
H	0.005 mg./liter for 10 min.	0.001 mg./liter
HN	0.003 do.	0.001 do.
ED	0.01 do.	0.005 do.
MD	0.01 do.	0.005 do.
CG	0.1 do.	0.1 do.
CC	0.05 do.	0.1 do.

b. Detection of surface contamination by persistent gases. The persistent gases, to which this kit is applicable, can be detected by holding the end of a detector tube within ¼ inch from the suspected surface while drawing the vapors through the tube. For further information, see paragraph 82.

c. Leaking gas shell in magazines. The presence of leaky shell in magazines can be detected by sampling the air of the magazine. If the magazine is large, a number of tests in various parts of the inclosure should be taken. The volume of sample will depend upon temperature, ventilation, and proximity of the leakers.

d. Detection of contaminated food, water, clothing, and other articles. Tests can be made on food, water, clothing, and other articles in the field. The tube should be close to but not touching the material. Tests should be made on shoes of personnel or tires of vehicles after traveling through an area of suspected contamination.

90. LIMITATIONS. There are certain limitations to the use of this kit, which, if thoroughly understood, can be overcome in most cases.

a. Limitations in the test for mustard gas or nitrogen mustard gas have been discussed in detail in paragraph 83.

b. The arsenical test is comparatively specific and there will be little danger of encountering a compound in the field, other than MD or ED, which will give a positive result.

c. The phosgene tube will give a reaction to diphosgene as well as to such compounds as benzoyl chloride. However in the case of benzoyl chloride, the reaction is not nearly as positive.

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SECTION III
LIQUID VESICANT DETECTOR PAINT

91. GENERAL. **a.** The *paint, liquid vesicant detector, M5* has been developed to supply a liquid blister gas detector with an adaptability greater than the liquid vesicant detector paper, M6. The paint is olive-green in color. It is a detector for spray or droplets only, and not for vapor. Drops or splashes of blister gases will turn the paint red wherever they strike. The advantage of such a paint lies in the fact that, by itself, it can be utilized as a camouflage paint for equipment such as the helmet or for vehicles. It serves, in addition, as an ever-ready detector of liquid blister gases. Ordinary decontaminants such as bleach, DANC, protective ointment M4, and some other war gases such as CNB will color the paint red in about the same manner as blister gases.

b. The paint is issued in metal cans of two sizes, 4 ounces and 32 ounces. (Fig. 73 shows the 4-ounce can.)

Figure 73. Liquid vesicant detector paint M5

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92. APPLICATION. The paint is applied by brush or spray to surfaces suitable for painting such as fences, lampposts, helmets, hoods or fenders of vehicles. It should constitute approximately half of the camouflage pattern on helmets, and on hoods and fenders of vehicles. Figure 74 illustrates the camouflage use of the paint on the helmet. In this instance the detector paint is the lighter of the two shades. Although the paint is touch dry within 2 hours, a considerably longer time is required for complete dryness. For this reason all painting should be carried out in the very late afternoon, dusk, or early evening to permit overnight drying. The paint loses much of its sensitivity to blister gases if exposed to the heat of the sun while wet.

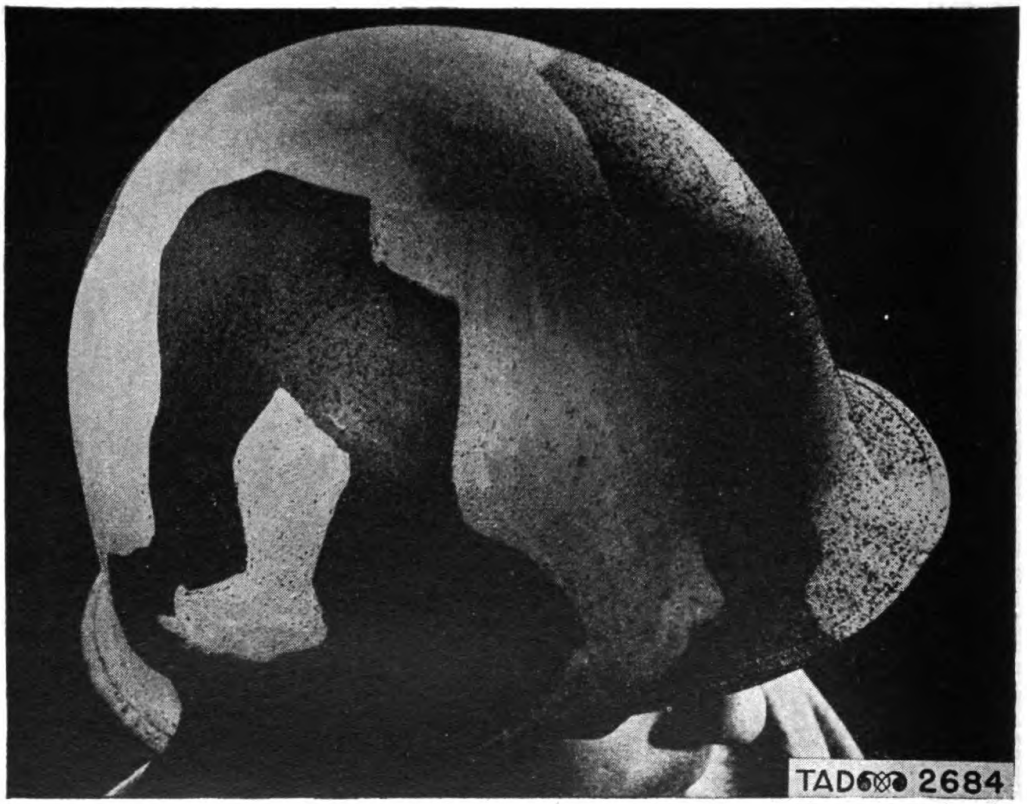

Figure 74. Detector paint used as camouflage paint on helmet

93. DURABILITY. The length of life of the paint under continuous exposure to severe conditions of heat and sun can safely be regarded as 2 to 3 weeks. Under milder conditions the life is much longer, extending, under temperate conditions, to months. When the color of the paint turns to yellow, it indicates that the usefulness of the paint has been destroyed by light. It should be understood that conditions which cause the deterioration of ordinary paint will also affect the detector paint. In the desert and the jungle it is difficult to predict exact durability of detector paint due to lack of knowledge of the amount of abrasion by sand or thick

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vegetation. Rough handling of detector-painted surfaces will also decrease the life of detector paint. Under severe conditions helmets and vehicle surfaces should be repainted every 2 or 3 weeks. Conditions of extreme heat, above 150° F., will cause the paint to turn reddish brown, in which case it is advisable to repaint the surface because of difficulty in distinguishing between this color and that caused by contact with liquid blister gases. Repainting may also be desirable for camouflage purposes.

SECTION IV
LIQUID VESICANT DETECTOR PAPER

94. GENERAL. The *paper, liquid vesicant detector, M6* is designed to detect the presence of any liquid blister gas. It gives no reaction to the vapor of blister gases. It consists of a sheet of paper 5½ inches long and 5 inches wide coated with paint, liquid vesicant detector, M5. The paper is issued in the form of booklets of 25 sheets, wrapped in a sealed cellophane cover (fig. 75).

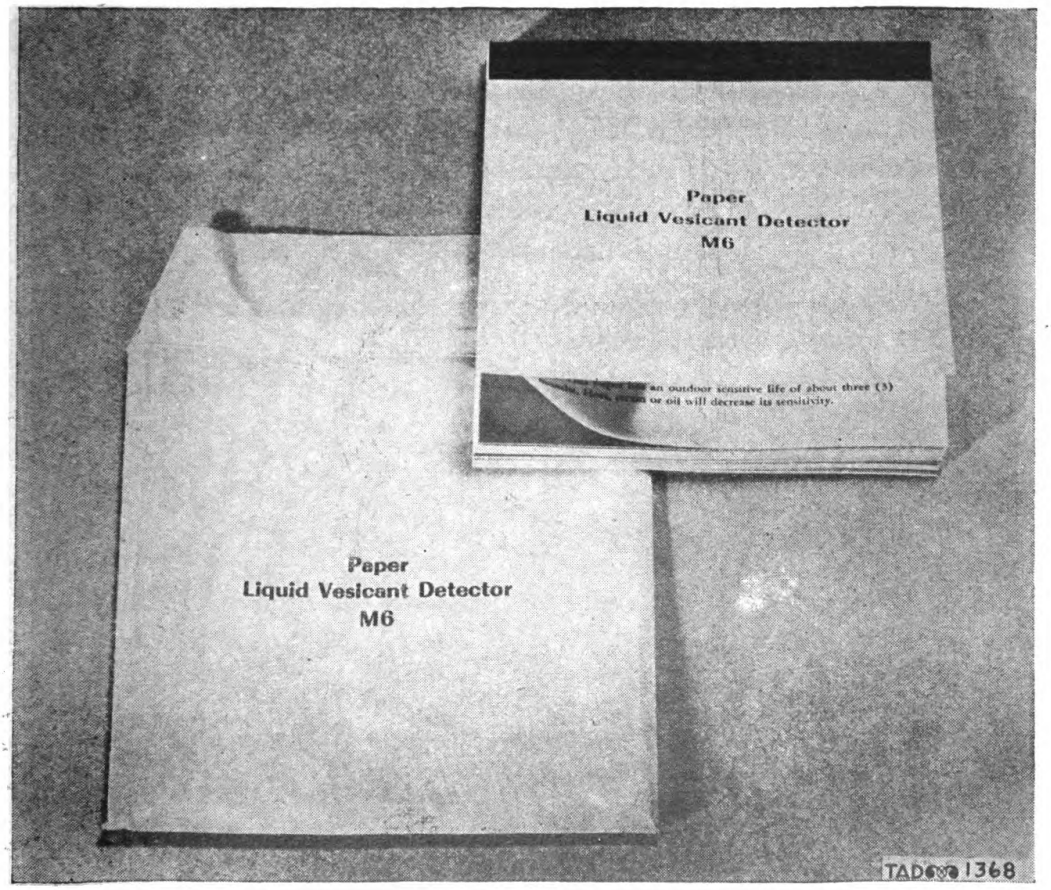

Figure 75. Liquid vesicant detector paper M6

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95. APPLICATION AND USE. **a.** Detach a sheet of detector paper from the booklet and place the sheet, coated (olive-drab color) side up, on a horizontal surface fully exposed to the fall of blister-gas spray.

b. Place the sheets at intervals of approximately 20 yards, depending on the surface area to be covered, and fasten with tape, tacks, or other suitable means.

c. The coated surface will turn a reddish color when liquid blister gases come in contact with it. A reddish fringe will show around the edge of dark stains or large splashes of liquid blister gas.

96. SENSITIVITY. This paper has an outdoor sensitive life of about 3 months. Heat, steam, or oil act to decrease the sensitivity (par. 93).

SECTION V
VESICANT DETECTOR CRAYON M7

97. DESCRIPTION. The *crayon, vesicant detector, M7* is in the form of a bright pink crayon or chalk wrapped in waterproof paper (fig. 76). Contact with liquid mustard gas or its concentrated vapors, as well as with liquid lewisite and ethyldichlorarsine, methyldichlorarsine, and phenyldichlorarsine, and their concentrated vapors causes an immediate color change from pink to bright blue. It can be used to detect contamination under conditions in which the liquid blister gas detector paint would fail. Upon contact with liquid nitrogen mustard gases no immediate effect can be noticed. However, on standing for a few minutes, the pink color

Figure 76. Detector crayon M7

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of the crayon will bleach out, leaving a yellowish spot. Concentrated vapors of nitrogen mustard gas, after prolonged contact, in some cases will cause a bluish color, but the effect is slight. A special crayon has been developed to give a more specific color change for the nitrogen mustard gases (sec. VI).

98. APPLICATION. In general, the crayon is applied to paper or other surfaces by rubbing the crayon over the surface, or by scraping it with a knife blade or other sharp edge to produce a dusting powder.

99. USE. a. Detection. (1) CONTAMINATED SURFACES. Surfaces contaminated with liquid blister gases can be tested by pressing a piece of the pink crayon-coated paper against the surface for ½ minute and then examining it for blue coloration. A more sensitive method, when conditions are suitable, is to coat the suspected surface with powdered crayon. A uniform but thin coating should be applied. The time required to show the color changes from pink to blue will depend on the degree to which the liquid blister gas has penetrated the surface. Actual liquid will cause an instantaneous change, while vapors from blister gas which has penetrated deeply may take as long as 10 minutes.

(2) CONTAMINATED WATER. Contamination of water can be detected, provided that some droplets are floating on the surface, which is usually the case if mustard gas has been sprayed on the water. The chalk is held over the suspected surface and scraped. The powder will float and turn blue where contact is made with droplets of mustard gas.

(3) LEAKING SHELL AND CONTAINERS. Gas shell and containers of mustard gas, lewisite, ethyldichlorarsine, methyldichlorarsine, and phenyldichlorarsine can be tested for leaks by making marks with the crayon on the surface near the seals. If crayon-coated papers are used, the coated surface must be held in contact with the suspected seal to insure the color change from pink to blue.

(4) DARK-COLORED BLISTER GASES. Crude blister gases which are too dark in color to be readily detected by the liquid blister gas detector paint can be detected by means of their action on the detector crayon. The crayon can be applied as a coating on paper, or better, by applying a coating of the powdered crayon to the suspected surface. The presence of a liquid blister gas in either instance will be shown by the appearance of a blue ring surrounding the dark spot. Dark-colored oils, mud, or other neutral liquids which may accidentally appear on the surfaces will not develop this reaction.

b. Differentiation. The pink detector crayon (M7) may be used to differentiate between the blister gases, H, L, and ED, and the type known as nitrogen mustard gases. In case a bleached yellowish spot is obtained upon testing a liquid, a nitrogen mustard gas is indicated. For proof of this, the special crayon for nitrogen mustard gases should be used (sec. VI).

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100. LIMITATIONS. **a.** The pink crayon (M7) is not specific for war gases, but is affected in a similar manner by strong acids such as hydrochloric and sulfuric. It is therefore sensitive to any of the war gases or other compounds which hydrolyze readily to give hydrochloric acid. Due regard must therefore be given to the possibility of the presence of such substances when interpreting results.

b. The material is sensitive to light and, in the form of a coating or powder, loses its sensitivity to blister gases and becomes discolored when exposed for some time to bright light. The crayon itself has good stability and even if exposed to light for a long time, only its surface will be affected. The light sensitivity, however, precludes its use as a spray detector where exposure of coating or powder to sunlight must be made over an extended period.

c. The sensitivity to mustard gas vapors is not high and can be relied on only where concentrated vapors are in contact with the indicator. Such a condition exists in close contact with contaminated surfaces. The crayon must not be relied on to detect the presence of low concentrations of mustard gas vapor.

SECTION VI
VESICANT DETECTOR CRAYON M8

101. GENERAL. The *crayon, vesicant detector, M8* is in the form of blue crayons or chalks which are wrapped in waterproof paper, 12 to a box. Each crayon is approximately 3 inches long and about ½ inch thick. Contact with the liquid nitrogen mustard gases or their vapors causes an immediate color change from blue to red. This detector crayon can be used in conjunction with the M7 detector crayon (sec. V) in order to differentiate between mustard gas and the nitrogen mustard gases.

102. APPLICATION AND USE. **a.** The application is the same as that given in paragraph 98 for the M7 detector crayon.

b. The use is the same as given in paragraph 99.

103. LIMITATIONS. The vesicant detector crayon M8 is not specific for war gases, but is affected in a similar manner by all strong alkalis such as ammonia and caustic soda. Attention must be given to the possibility of the presence of such substances when interpreting results. The crayon is not sensitive to light or moderate heat and is a good spray detector.

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CHAPTER 7
GAS ALARM EQUIPMENT

SECTION I
GAS ALARM, M1

104. GENERAL. The *alarm, gas, M1* is a device used exclusively to give warning when the presence of gas is recognized. It has a distinctive sound and for this reason must never be used for any other purpose. All personnel should be informed as to its use and become familiar witn its sound.

105. DESCRIPTION. The M1 alarm consists of three main components (fig. 77) : shoulder straps, gong, and striker.

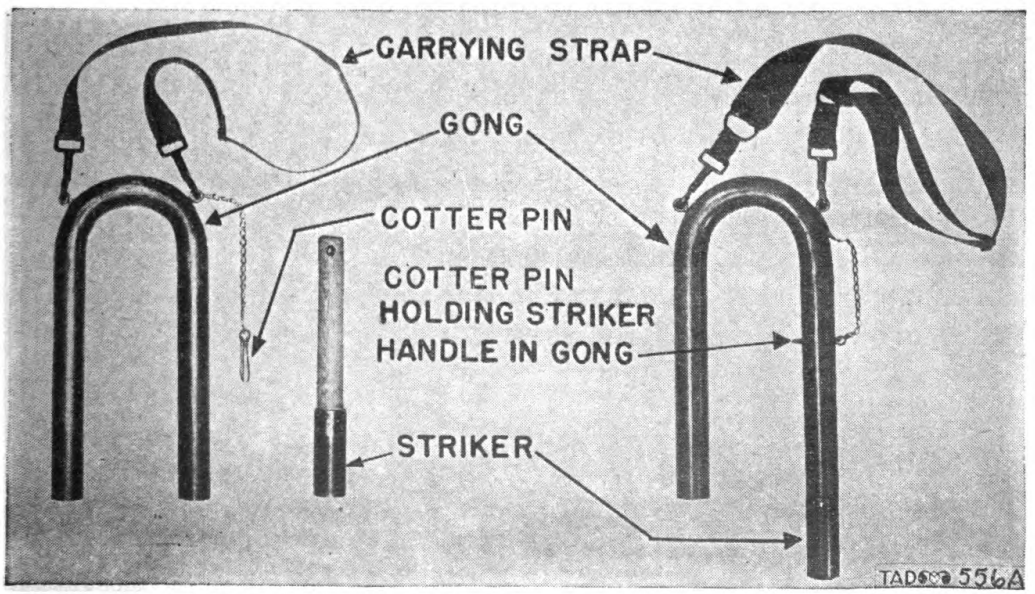

Figure 77. Component parts of gas alarm M1

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a. The shoulder straps are made of olive drab, cotton webbing and are adjustable.

b. The gong is a steel tube (about 1½ inches in diameter) bent in a U-shape. It is approximately 15 inches long. The shoulder strap is connected to the gong by means of two round-eye snaps.

c. The striker consists of a steel tube with a wooden handle. Over-all length of the striker is about 12 inches. The combined weight of the three components is approximately 5 pounds.

106. ASSEMBLY AND USE. a. To assemble and use the alarm, the cotter pin (fig. 77) is pulled out. This pin holds the handle of the striker inside the gong when the alarm is not in use. Next, hold the shoulder straps and striker as shown in figure 78 and strike the interior sides of the U-shaped gong. It is not necessary to hold the gong as shown in figure 78, but instead it may be suspended from a limb of a tree or any other convenient place.

b. It should be remembered, however, that before the alarm is sounded the sentry entrusted with its use should adjust his gas mask.

SECTION II
SUBSTITUTE ALARMS

107. GENERAL. Occasions may arise where a substitute for the gas alarm, M1 will be required due to lack of sufficient number of the M1 type or the unavailability of the M1 alarm. Empty 75- or 105-mm shell cases, iron rod for triangles, bells, or the British gas rattle can be utilized for this purpose. Any method, preferably percussion, which will give a characteristic and unmistakable sound may be used. Troops should be thoroughly familiar with the nature of the alarm system, its use, and most important of all, its characteristic sound.

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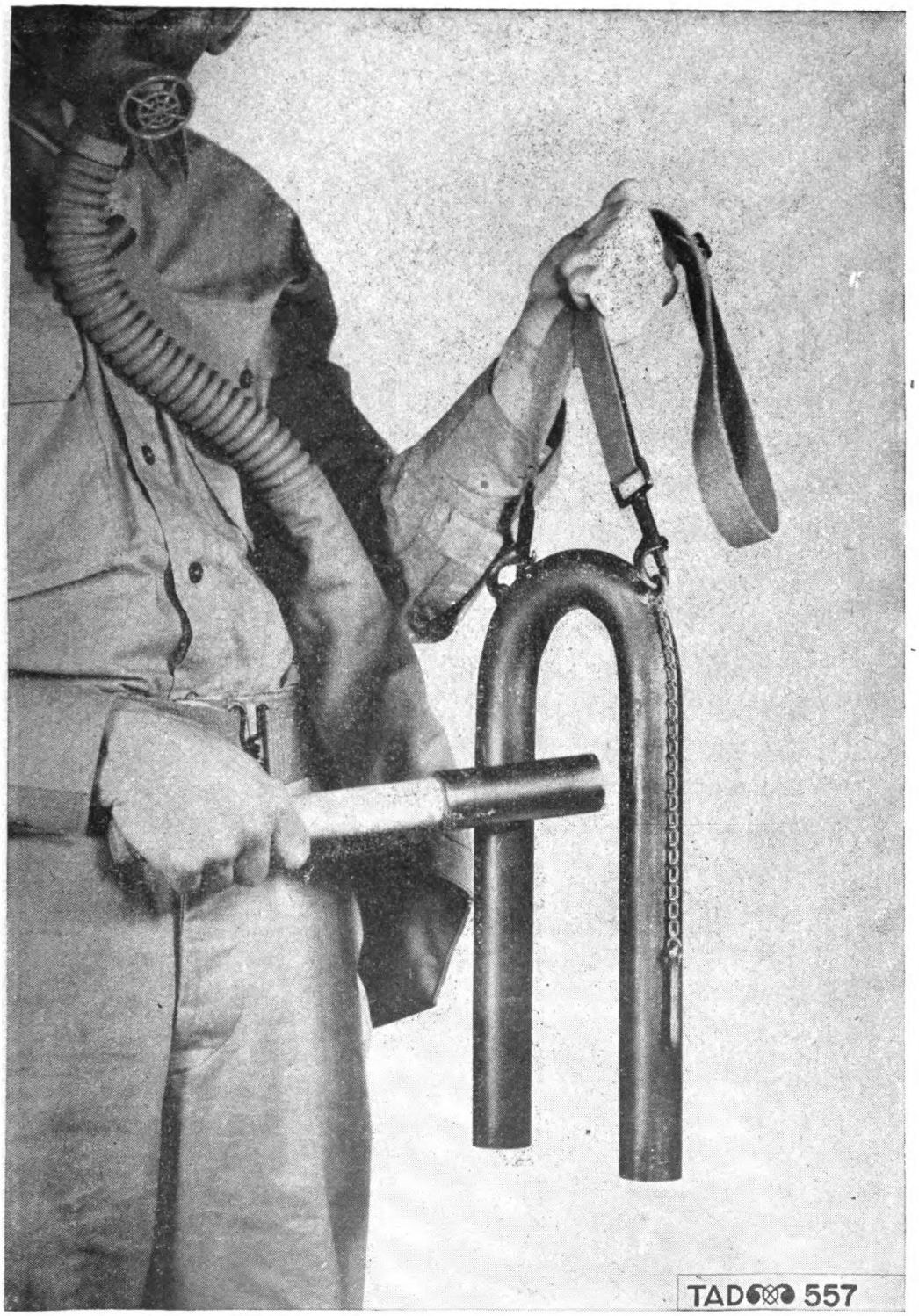

Figure 78. Sounding gas alarm M1

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